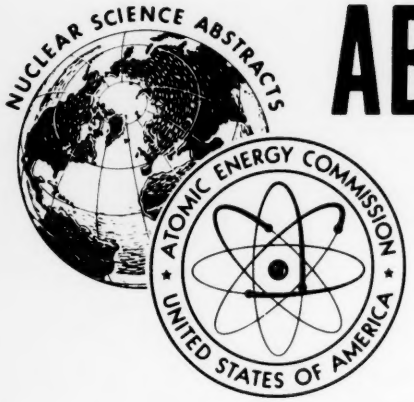
NUCLEAR SCIENCE ABSTRACTS



Volume 27 Number 11

Abstracts 24284-27282

June 15, 1973

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Volume 27, Number 11, June 15, 1973

NUCLEAR SCIENCE ABSTRACTS

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Nuclear Science Abstracts provides the only comprehensive abstracting and indexing coverage of the international nuclear science literature. It covers scientific and technical reports of the U. S. Atomic Energy Commission and its contractors, other U. S. Government agencies, other governments, universities, and industrial and research organizations. In addition, books, conference proceedings, individual conference papers, patents, and journal literature on a worldwide basis are abstracted and indexed. Each issue of *Nuclear Science Abstracts* includes four indexes: subject, personal author, corporate author, and report number.

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NEWCOMB, William A., Stability of a magnetic well, 25:1239
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TRANSURANIUM ELEMENTS
determination in bone ash, radiochemical method for, 25:40 (IDO-12073, pp 28-36)
separation by ion exchange and complex-formation elution, 25:251(P)
TRIETHYLENETETRAMINE
complexes with cobalt(III) and rhodium(III) chlorides, radiation effects on labeled, thermal-neutron, 25:137
TRITIUM
content in Cattaraugus Creek near West Valley Processing Plant, July through Dec. 1969, 25:258 (DOCKET-50201-48)
content in Cattaraugus Creek near West Valley Processing Plant, Jan. to July 1970, 25:259 (DOCKET-50201-49)
determination in luminescent material by scintillation counting, 25:40 (IDO-12073, pp 28-36)

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372 (UCRL-72739) CONSTRUCTION OF A UNIQUE UNDERGROUND WHOLE BODY COUNTER. Griffith, R. V.; Anderson, A. L.; Lindeken, C. L. **(California Univ., Livermore. Lawrence Radiation Lab.).** Oct 1970. 27p. (CONF-701009-1). Dep. NTIS.

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CALIFORNIA UNIV., LIVERMORE. LAWRENCE RADIATION LAB.
Construction of a unique underground whole body counter, 25:372 (UCRL-72739)

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Dissertations from *Dissertation Abstracts International, Part B* that are included in *Nuclear Science Abstracts* are available from University Microfilms, Inc., 315 N. First Street, Ann Arbor, Michigan 48103.

Information on the availability of the published literature and unpublished conference papers abstracted in *Nuclear Science Abstracts* can be obtained from the USAEC Technical Information Center, P. O. Box 62, Oak Ridge, Tennessee 37830.

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NUCLEAR SCIENCE ABSTRACTS

CHEMISTRY

24284 (AEC-tr-7223/7-8) NUKLEONIKA, VOL. 16, No. 7-8, 1971. Translation of Nukleonika; 16: No. 7-8, 311-398(1971). 79p. (TT-70-55104/7-8). Dep. NTIS $6.00.

24285 ABSTRACTS OF PAPERS. American Chemical Society 165th National Meeting, Dallas, Texas, April 8-13, 1973. Washington, D. C.; American Chemical Society (1973). 385p. (CONF-730403-(Absts.)). $9.00.

Abstracts of papers given at the 165th annual meeting of the American Chemical Society are presented. The following divisions are included: agricultural and food chemistry; analytical chemistry; carbohydrate chemistry; cellulose, wood, and fiber chemistry; chemical education; chemical marketing and economics; colloid and surface chemistry; fluorine chemistry; fuel chemistry; history of chemistry; industrial and engineering chemistry; inorganic chemistry; medicinal chemistry; organic chemistry; organic coatings and plastics chemistry; pesticides chemistry; petroleum chemistry; physical chemistry; professional relations; and water, air, and waste chemistry. (JGB)

Analytical Chemistry

Activation and Nuclear Reaction Procedures

Refer also to abstract 24796.

24286 (AERE-R-7134) AN ANALYTICAL STUDY OF TRACE ELEMENTS IN THE ATMOSPHERIC ENVIRONMENT. Cawse, P. A.; Peirson, D. H. (eds.). (Atomic Energy Research Establishment, Harwell (England)). Oct 1972. 39p. Dep. NTIS (U. S. Sales Only) $4.00. UK 1.00 pound.

The levels of about 30 trace elements were determined in airborne dust, rainwater, and dry deposition at a single rural site in north-west England during a period of nearly two years. Regular samples were analyzed by neutron activation followed by automatic gamma spectrometry, or by x-ray fluorescence. Methods of sampling, sample preparation, and analysis were shown to have adequate accuracy and precision. The basic parameters, trace element contents in air, rain, and dry deposition can be combined to produce two additional derived parameters, "washout factor" W that relates to the vertical atmospheric distribution of a trace element, and "dry deposition velocity" Vg that relates to particle size. The highest concentrations measured in air were for Cl, Na, Ca, Al, Fe, Pb, and Zn. There was a general increase in concentrations during the winter. A correlation was carried out of concentrations and wind direction for a limited number of elements. The amounts of the total deposition measured on to the ground generally follow those of the concentrations in air: in the case of certain elements the dry deposition accounts for a significant proportion of the total. By reference to the values of Vg against W, most of the elements present in detectable quantities may be divided into three categories-maritime (Na and Cl), soil-derived, and artificial or industrial. The first has large Vg and W, the second large Vg and low W, and the third low Vg and W. (auth)

24287 (BNWL-1183-13) MEASUREMENT OF RADIATION EXPOSURE OF ASTRONAUTS BY RADIOCHEMICAL TECHNIQUES. Quarterly Research Report to the NASA Manned Spacecraft Center, October 2, 1972-December 31, 1972. Brodzinski, R. L. (Battelle Pacific Northwest Labs., Richland, Wash.). 15 Jan 1973. Contract AT(45-1)-1830. 20p. Dep. NTIS $3.00.

A cosmic radiation dose to the Apollo 16 crew of 180 ± 100 mR was calculated from the specific activities of ^{22}Na and ^{24}Na in pre- and postflight urine specimens. The specific activities of ^{51}Cr and ^{60}Co are higher in postflight specimens than in preflight specimens, presumably due to a postflight injection of radiochromium. The ^{59}Fe and ^{137}Cs specific activities are also reported and appear to be normal. The radiation doses received by a pilot and a navigator flying a high altitude mission during the solar flare of August 4 to 9, 1972 were calculated from the specific activity of ^{24}Na in their urine. These values are compared with the expected radiation dose calculated from the known shape and intensity of the proton spectrum. They demonstrate the magnitude of atmospheric shielding. The concentrations of Ca, Na, Rb, Cs, Cr, Fe, Co, Ag, Zn, Hg, As, Sb, Se, Br, Sc, Hf, and Ta were measured in urine specimens from the Apollo 16 astronauts by neutron activation analysis. Scandium, hafnium, and tantalum concentrations are reported for the first time. The concentrations and excretion rates of Ca, Zn, As, and Se are normal. Sodium, rubidium, cesium, and bromine exhibit significantly reduced postflight excretion rates, whereas chromium and silver are generally higher in these samples. The concentrations and excretion rates of Fe and Co are the lowest ever observed; those of Hg and Sb are lower than the high values measured after the Apollo 14 and 15 missions. (auth)

24288 (BNWL-SA-4288) FEASIBILITY OF DETERMINING TOTAL BODY CALCIUM BY MEASURING ^{37}Ar IN EXPIRED AIR AFTER LOW LEVEL IRRADIATION WITH 14-MeV NEUTRONS. Palmer, H. E. (Battelle Pacific Northwest Labs., Richland, Wash.). [nd]. Contract AT(45-1)-1830. 11p. (CONF-720471-1). Dep. NTIS $3.00.

From Panel on in vivo activation analysis; Vienna, Austria (17 Apr 1972).

During the irradiation of bone by 14 MeV neutrons a small quantity of the calcium is converted to ^{37}Ar by an (n,α) reaction. The ^{37}Ar leaves the bone and is released from the body through the expired air. This small amount of ^{37}Ar can be separated and purified from the other gaseous components and the quantity can be determined very efficiently by counting internally with a small proportional counter. The time required for more than 95% of the ^{37}Ar to leave the body is about 1 hr for rats, $1\frac{1}{2}$ hrs for dogs, and is expected to be no more than 2 hrs for humans. Satisfactory total body calcium measurements in humans should be possible with a radiation dose as small as 0.001 rad. This would be a factor of 50 to 200 times lower dose than that used at present in vivo neutron activation methods for total body calcium. This article describes the techniques and apparatus developed to perform these studies, discusses the results of experiments with rats and dogs, and predicts the usefulness of this technique for use with human patients. (auth)

24289 (CONF-721010-28) ELEMENTAL AND ISOTOPIC DETERMINATION OF LITHIUM BY THE COINCIDENCE MEASUREMENT OF COMPLEMENTARY PARTICLES. Pretorius, R.; Coetzee, P. P.; Peisach, M. (Southern Universities Nuclear Inst., Faure (South Africa); Stellenbosch Univ. (South Africa). Dept. of Chemistry). 1972. 10p. Dep. NTIS (U.S. Sales Only).

From International conference on modern trends in activation analysis; Saclay, France (2 Oct 1972).

The coincident measurement of both nuclear products at their complementary angles was used to determine lithium-6 by the reactions $^{6}Li(d,\alpha)^{4}He$ and $^{6}Li(p,\alpha)^{3}He$, and lithium-7 by the reaction $^{7}Li(p,\alpha)^{4}He$. Elemental lithium was determined in natural

samples or samples of known isotopic composition. Isotopic analyses could be carried out over the entire range from 0 to 100 atom % with a relative standard deviation of about 4%. The CMCP technique is highly specific and effectively eliminates interference and background. (France)

24290 (CONF-721010-35) DETERMINATION OF LIGHT ELEMENTS IN SURFACE LAYERS. Meshcheryakov, R. P.; Chernov, I. P.; Oblivantsev, A. N.; Kuznetsov, B. I.; Tronov, G. I.; Rybasov, A. G. 1972. 19p. (In Russian). Dep. NTIS (U. S. Sales Only).

From International conference on modern trends in activation analysis; Saclay, France (2 Oct 1972).

A method for determining elements in a 15 micron thick surface film is presented. The anomalous increase in the scattering cross sections of light nuclei observed at large angles for high energy α particles was examined. An isotopic exchange method acting between the solid and liquid phases was used to rapidly separate the short half-life fluorine from the impurities. (France)

24291 (CONF-721010-44) NEUTRON ACTIVATION DETERMINATION OF LANTHANUM IN PRASEODYMIUM OXIDE NEAR THE DETECTION LIMIT. COMPARISON OF VARIOUS PROCEDURES. Dybczynski, R.; Sterlinski, S.; Golian, C. (Institute of Nuclear Research, Warsaw (Poland)). 1972. 18p. Dep. NTIS (U. S. Sales Only) $3.00.

From International conference on modern trends in activation analysis; Saclay, France (2 Oct 1972).

Trace amounts of La were determined in spectroscopically pure praseodymium oxide using four independent methods: nondestructive Ge(Li) spectrometry; spectrometry of slow $\gamma-\gamma$ coincidences; radiochemical separation of ^{140}La from macroquantities of ^{142}Pr and other interfering activities (principally ^{192}Ir, ^{194}Ir, ^{152}Eu, and ^{154}Eu) with an approximate 100% yield, a method involving several ion exchange processes followed by NaI(Tl) spectrometry; and a method of standard additions using radiochemical separation. Only the last two methods give accurate results near the limit of detection. (France)

24292 (CONF-721010-45) CONTRIBUTION TO THE USE OF DATA PROCESSING TO ESTABLISH INSTRUMENTAL MULTI-ELEMENT ACTIVATION ANALYSIS AS A ROUTINE METHOD. Gierl, A.; Lux, F. (Technische Universitaet, Munich (West Germany). Institut fuer Radiochemie). 1972. 9p. Dep. NTIS (U. S. Sales Only) $3.00.

From International conference on modern trends in activation analysis; Saclay, France (2 Oct 1972).

The data processing consisted of 3 main procedures: analysis of the spectrum, i.e., assignment of energies and intensities to the photopeaks; qualitative analysis of chemical elements from the photopeaks; and quantitative determination of the identified elements. The program involved the fitting of Gaussian curves and was particularly effective for the resolution of double peaks. (France)

24293 (CONF-721010-46) INSTRUMENTAL NEUTRON ACTIVATION ANALYSIS LIMITS OF DETECTION IN THE PRESENCE OF INTERFERENCES. Guinn, V. P. (California Univ., Irvine). 1972. 5p. NTIS.

From International conference on modern trends in activation analysis; Saclay, France (2 Oct 1972).

A method is presented for estimating in advance, the instrumental neutron activation analysis (NAA) limits of detection for any elements of interest in any given matrix, including ones generating high interference levels. The rationale of the method is presented, and the procedure for applying it is illustrated. (France)

24294 (CONF-721010-48) USE OF NONDESTRUCTIVE HIGH ENERGY γ PHOTON ACTIVATION FOR TRACE ELEMENT SURVEY ANALYSIS. Hislop, J. S.; Williams, D. R. (Atomic Energy Research Establishment, Harwell (England)). 1972. 11p. Dep. NTIS (U.S. Sales Only) $3.00.

From International conference on modern trends in activation analysis; Saclay, France (2 Oct 1972).

An empirical study was made of the potential of high energy γ photon activation and high resolution spectrometry for the survey analysis of trace elements in a variety of materials. Human blood, urine, bone ash, standard glass (NBS, SRM612), and air particulates, along with synthetic multi-element standards, were studied following irradiation with γ photons of maximum energy 17 to 45 MeV. Elements found to be suited to determination by γ activation include Sb, As, Bi, Cd, Cs, Ca, Ce, Cr, Fe, Au, Pb, Mg, Mo, Ni, Nb, Rb, Sr, Tl, Ti, Tm, Zn, and Zr. Gamma spectra, elemental concentrations measured, and/or limits of detection observed for the matrices studies are given. (auth)

24295 (CONF-721010-49) ACTIVATION ANALYSIS OF HEAVY METALS IN SURFACE WATERS USING ION EXCHANGE FILTER PAPERS AND CYANIDE COMPLEXING. Kolaczkowski, A.; Jester, W. A. (Pennsylvania State Univ., University Park. Dept. of Nuclear Engineering). 1972. 10p.

From International conference on modern trends in activation analysis; Saclay, France (2 Oct 1972).

A simple, reasonably rapid, and accurate technique developed for the multi-element analysis of heavy metals in surface waters using ion exchange filter papers and cyanide complexing in conjunction with neutron activation analysis is described. The method employs large water volume irradiation for improved sensitivity. Tellurium-130 was used as an internal flux monitor to correct for neutron flux variations in the samples. Proof of the value of this technique was obtained by the analysis of 10 surface water samples previously analyzed using conventional methods by the U. S. Geological survey of the U. S. Department of Interior. Good agreement resulted from this comparison. (auth)

24296 (CONF-721010-51) DETERMINATION OF ^{235}U IN HIGHLY ENRICHED REACTOR FUEL STICKS. Lukens, H. R.; Fleishman, D. M.; Bramblett, R. L. (Gulf Radiation Technology, San Diego, Calif). 1972. 6p.

From International conference on modern trends in activation analysis; Saclay, France (2 Oct 1972).

Measurement of uranium in highly enriched reactor fuel sticks has been achieved by elaboration of the method of Amiel. Calibration of the method was achieved by three methods: comparison of dissolved sample with aqueous standard, comparison of sample with handcrafted standard stick, and the extrapolated-aliquot procedure. Precision and accuracy of <0.5% relative are achieved in <2 minute measurement time on a production basis. Precisions of <0.1% relative are achieved in replicate measurements. (auth)

24297 (CONF-721010-52) ULTIMATE CONTRIBUTION OF NUCLEAR ACTIVATION TO ANALYSIS. Meinke, W. W. (National Bureau of Standards, Washington, D. C.). 1972. 35p.

From International conference on modern trends in activation analysis; Saclay, France (2 Oct 1972).

The advantages of activation analysis over other methods of analysis are examined. Sensitivity, accuracy (checked using reference standards), the present status of developments in trace analysis, and developments envisaged in the future are discussed. (France)

24298 (CONF-721010-54) RADIOCHEMICAL DETERMINATION OF TRACE NOBLE METALS. Randle, K.; Wellum, R.; Whitley, J. E. (Scottish Research Reactor Centre, East Kilbride (Scotland)). 1972. 15p. Dep. NTIS (U.S. Sales Only) $3.00.

From International conference on modern trends in activation analysis; Saclay, France (2 Oct 1972).

Radiochemical separations are essential for the determination of trace elements in silver artefacts by neutron activation analysis due to the high levels of both short and long-lived activities produced by the matrix, but the sensitivity of the technique permits the examination of small samples. The noble metals are considered most significant from a diagnostic standpoint, and radiochemical techniques have been developed for their determination in samples of a few milligrams. Methods have been investigated for the determination of Pd, Rh, Ir, and Pt in samples removed from museum specimens of known provenance. (auth)

24299 (CONF-721010-55) USE OF A HIGH EFFICIENCY MASS SEPARATOR IN ACTIVATION ANALYSIS. Rook, H. L.; Lutz, G. J.; LaFleur, P. D. (National Bureau of Standards, Washington, D. C.). 1972. 15p.

From International conference on modern trends in activation analysis; Saclay, France (2 Oct 1972).

The application of high-yield mass separators to problems in activation analysis is discussed. Separation parameters including separator yields, memory, resolution and overlap, and sputtering are considered. The use of the mass separator in determining lead in standard glass by photon activation analysis is described. (auth)

24300 (CONF-721069-29) TRACE DETERMINATION IN SEMICONDUCTORS USING NEUTRON ACTIVATION ANALYSIS. Hoste, J. (Ghent Rijksuniversiteit (Belgium). Institutt voor Kernwetenschappen). 1972. 22p. (In French). Dep. NTIS (U.S. Sales Only).

From International colloquium on the activation analysis of micro-quantities of elements in very high purity inorganic and organic substances and in biological media; Saclay, France (2 Oct 1972).

A method for determining traces in Ge, Si, and Se is described. The following elements can be determined using gamma spectrometry techniques, possibly preceeded by chemical separation: As, Cu, Au, Ga, Zn, Hg, Cr, Sn, Sb, Co, In, Ni, Ir, Se Sc, Ag, Ta, Hf, and U in Ge; P, Au, Sb, Ga, Fe, K, Cr, Mo, Sn, As, Co, In, Zn, Cu, W, Ta, Na, Eu, Sm, La, Sc, and Tl in Si; and Cl, Br, I, P, S,

Te, Na, K, Cr, Fe, Co, Cu, Zr, Ga, Sc, Ag, Cd, La, W, Au, and Tl in Se. The concentrations and detection limits vary between a few parts per million and 10^{-3} parts per thousand million. (Tr-auth)

24301 (ORNL-NSF-EP-43) TRACE ELEMENT MEASUREMENTS AT THE COAL-FIRED ALLEN STEAM PLANT. Progress Report, June 1971–January 1973. Bolton, N. E.; Van Hook, R. I.; Fulkerson, W.; Lyon, W. S.; Andren, A. W.; Carter, J. A.; Emery, J. F. (Oak Ridge National Lab., TENN). Mar 1973. Contract W-7405-eng-26. 80p. Dep. NTIS $6.00.

Oak Ridge National Laboratory is investigating the disposition of trace elements from coal combustion at the Tennessee Valley Authority (TVA) Thomas A. Allen Steam Plant in Memphis, Tennessee. The study consists of two parts: (a) in-plant sampling to obtain a mass balance for an extensive suite of elements and (b) sampling in the environment around the plant to ascertain the fate of the discharges of these elements. To date, with the assistance of TVA, one set of in-plant sampling runs for one of the three independent cyclone boilers at the plant has been obtained consisting of representative specimens of coal, bottom ash from the slag tank, fly ash in the precipitator inlet and outlet collected isokinetically at a representative series of duct locations determined by the gas flow profiles, and fly ash in the stack gases collected isokinetically at the 268 ft level. Measurements by neutron activation analysis, spark source mass spectroscopy (with isotope dilution for some elements), and atomic absorption spectroscopy yielded an approximate balance for many elements. Exceptions were those elements forming volatile compounds such as Hg, and possibly As. For most elements contained in the fly ash, the electrostatic precipitators (newly installed) were extremely efficient. A notable exception seems to be Se. Samples collected in the environment include: six-inch soil cores and mosses taken at varying distances from the plant, along a north-south transect corresponding to the prevailing winds; Hi-vol atmospheric particulate samples upwind and in the stack plume; atmospheric fallout; ash pond discharge water; sediment and water from the stream receiving the ash pond runoff; and Mississippi River water. The soil measurements show variations in concentrations with distance from the plant. However, it is concluded that no appreciable part of the soil concentration variations can be attributed to the steam plant since none of the cores showed significant variations with depth for any of the elements and the soil concentrations for a number of elements showing the variations with distance were equal to or greater than that found in the fly ash itself. Measurements of the elemental composition of the other specimens collected have not yet been completed. (auth)

24302 DETERMINATION OF GOLD IN PHOSPHATES BY ACTIVATION ANALYSIS USING EPITHERMAL NEUTRONS. Rowe, J. J. J. Res. U. S. Geol. Surv.; 1: No. 1, 79-80(1973).

A simple method is described for determining gold in phosphates and phosphatic materials. Samples in a cadmium container are irradiated with epithermal neutrons to minimize the formation of ^{32}P, while permitting the formation of adequate amounts of ^{198}Au. Fire assay–radiochemical methods are used to separate the ^{198}Au. Concentrations as low as 0.1 ppB can be determined readily while maintaining low radiation levels. (auth)

24303 ANALYSIS OF NITROGEN IN GRAIN BY PHOTONUCLEAR ACTIVATION ANALYSIS. Brune, D.; During, L.; Larsson, B.; Lundqvist, H. (Uppsala Univ.). Int. J. Appl. Radiat. Isotop.; 24: No. 1, 1-6(Jan 1973).

The application of a betatron in the photonuclear activation analysis of nitrogen in wheat grain was investigated instrumentally by measuring the annihilation radiation of ^{13}N. The measurement of ^{11}C originating from carbon was used for internal standardization. The irradiations were carried out at selected maximum bremsstrahlung energies. The interference from ^{38}K formed from potassium occurring in the grain samples was evaluated. The simultaneous determination of the water content of the grain sample is discussed. (auth)

24304 SIMULTANEOUS DETERMINATION OF ARSENIC, MANGANESE, AND SELENIUM IN BIOLOGICAL MATERIALS BY NEUTRON-ACTIVATION ANALYSIS. Heydorn, K.; Damsgaard, E. (Danish Atomic Energy Commission, Risoe). Talanta; 20: No. 1, 1-11(Jan 1973).

A new method was developed for the simultaneous determination of arsenic, manganese, and selenium in biological material by thermal neutron activation analysis. The use of ^{81m}Se as indicator for selenium permitted a reduction of activation time to 1 hr for a 1 g sample, and the possibility of loss of volatile compounds during irradiation could be dismissed. No pretreatment of the sample is required, and the radiochemical separation scheme is based on simple chemical operations, completed in less than 3 hr. A systematic experimental investigation of the performance characteristics of the method was carried out, including studies of the accuracy of the results. The actual precision achieved in routine application of the method in the analytical laboratory was in good agreement with the calculated precision, and the results are therefore well suited for statistical evaluation of differences at the ppM level in samples of biological tissue. (auth)

24305 TRACE ELEMENT ANALYSIS IN WATER BY PROTON ACTIVATION. Bankert, S. F. (Univ. of California, Davis); Bloom, S. D.; Sauter, G. D. Anal. Chem.; 45: No. 4, 692-697 (Apr 1973).

Charged particle activation analysis (CPAA) was applied to the measurement of trace amounts of pollutants in calibrated water samples. The activating particles are 14.7 MeV protons in a microampere (or less) beam from the Lawrence Livermore Laboratory 30-inch cyclotron. The short half-life gamma spectrum ($T_{\frac{1}{2}} \lesssim 2$ min) of the activated sample is assayed in a NaI–Ge(Li) anticoincidence detector system. A fast transit system carries the sample from the bombardment site to the counting position in about 1.8 seconds. As of now, the technique is capable of simultaneously detecting ppM quantities of boron, nitrogen, bromine, selenium, sodium, cadmium, and chromium in concentrated water samples evaporated to dryness on tantalum foils. (auth)

24306 MEDICAL APPLICATIONS OF CYCLOTRON PROCEDURES: TOTAL BODY CALCIUM AS DETERMINED BY NEUTRON ACTIVATION ANALYSIS. Chestnut, C. H. III; Nelp, W. B.; Denney, J. D. (University Hospital, Seattle). AIP (Amer. Inst. Phys.). Conf. Proc.; No. 9, 646-649(1972).

From sixth international cyclotron conference; Vancouver, B. C. (18 Jul 1972).

See CONF-720717-.

Knowledge of the pathophysiology and treatment of various metabolic bone diseases is enhanced by accurate measurement of total bone mineral mass and precise estimation of bone mass change. Such measurements of total body calcium (TBC) and calcium balance are possible utilizing the technique of total body neutron activation analysis. A 60 inch cyclotron yields 22 MeV deuterons which produce neutrons between 4 and 12 MeV upon striking a beryllium target. Patients are irradiated with a 200 millirad dose over a 1.5 minute period; ^{48}Ca is converted to ^{49}Ca through a (n,γ) reaction and the ^{49}Ca is subsequently quantitated in a whole body counter. This technique detects absolute levels of TBC with a ±5.2% accuracy and plots serial net changes (calcium balance) with ±2% precision. To date 230 measurements have been performed in 115 patients with bone mineral metabolism disorders, including osteoporosis, osteomalacia, renal osteodystrophy and multiple myeloma. (auth)

Chemical and Spectral Procedures

Refer also to abstract 24513.

24307 (BARC-638) SPECTROPHOTOMETRIC DETERMINATION OF URANIUM IN COMMERCIAL WET PROCESS PHOSPHORIC ACID AND PHOSPHATE ROCK USING THIOCYANATE. Nagle, R. A.; Murthy, T. K. S. (Bhabha Atomic Research Centre, Bombay (India)). 1972. 15p. Dep. NTIS (U. S. Sales Only) $3.00.

A method was worked out for the determination of uranium in commercial wet process phosphoric acid and rock phosphate. It is based on the separation of uranium from interfering ions by its extraction from a solution containing aluminum nitrate using TBP diluted with petroleum ether. By contacting the TBP extract with an aqueous solution containing ammonium thiocyanate, the uranium in the organic layer is converted into the colored thiocyanate complex. Suitable modifications were made in the procedure for analysis of samples low in uranium. The method is believed to be simple and reliable. (auth)

24308 (GAT-T-1903) DEVELOPMENT OF GAS CHROMATOGRAPHIC METHODS FOR ANALYSIS OF CORROSIVE FLUORIDES. Swope, L. G.; Smith, E. A. (Goodyear Atomic Corp., Piketon, Ohio). 28 Dec 1972. Contract AT(33-2)-1. 36p. (CONF-730314-1). Dep. NTIS $4.00.

From 24th Pittsburgh conference on analytical chemistry and applied spectroscopy; Cleveland, Ohio, USA (5 Mar 1973).

A gas chromatograph (GC) is being used to perform corrosive gas analyses which have been difficult or impossible using previously available techniques (e.g., the analysis of F_2 in the presence of air and ClF_3). The instrument is a commercially available, cryogenically programmed unit which was modified for corrosive service by the installation of an all-nickel tubing system, a nickel and Teflon sampling valve, and a nickel thermoconductivity detector. The GC has also been modified to include a temperature programming capability ranging from −170°C to +300°C. Two gas separation columns for use with this instrument have been pre-

pared and tested. A column of poly(hexafluoropropylene oxide) coated on Teflon powder is being used to separate fluorocarbons (e.g., C_2F_6, CF_4, CF_3Cl, $C_2F_4Cl_2$) in mixtures containing corrosive fluorides. A second column, packed with fluorinated graphite $[(CF_x)_n]$, is being used with cryogenic programming to analyze gas mixtures containing extremely low boiling gases such as F_2 and N_2. This column has been particularly useful for the determination of F_2 and Cl_2 in the presence of air, ClF, and ClF_3. (auth)

24309 (JEN-243) METHOD FOR DETERMINING MICRO-AMOUNTS OF URANIUM IN SOLUTIONS FROM COPPER ORES, BY LIQUID–LIQUID EXTRACTION AND SPECTROPHOTOMETRY WITH ARSENAZO III. Rodriquez, B. (Junta de Energia Nuclear, Madrid (Spain). Division de Materiales). 1972. 15p. (In Spanish). Dep. NTIS (U. S. Sales Only) $3.00.

A spectrophotometric method is described for determining small amounts of uranium in aqueous solutions from copper ores. Uranium is quantitatively separated in a single extraction by a solution of tri-n-octylphosphine oxide in benzene, using ethylendiaminetetraacetic acid and sodium fluoride as complexing agents, for improving the selectivity of the procedure. An aliquot of the extract is diluted with a hydroalcoholic solution of arsenazo III. Optical density is measured at 650 nm. Relative error less than 10% is obtained for samples containing between 1 and 5 mg U/l, in presence of iron and copper up to 10 g Fe/l and 40 g Cu/l. (auth)

24310 (NLCO-tr-11) MANUFACTURE OF URANIUM CHECK SPECIMENS FOR SPECTROGRAPHIC ANALYSIS. Neuilly, M. (Commissariat a l'Energie Atomique, Cadarache (France). Centre d'Etudes Nucleaires). Translation from pp 115-123 of STI/PUB-291. (CONF-711107-14). 1972. 8p. Dep. NTIS.

From Symposium on analytical methods in the nuclear fuel cycle; Vienna, Austria (29 Nov 1971).

Conditions under which 12 uranium billets were prepared as reference materials for spectrographic analysis are described. The impurities were added in two different ways: some were present in the basic uranium and the others were added in elemental form to the uranium during casting. The results of impurity determinations performed by several laboratories using different methods are presented, and also the probable concentrations. (auth)

24311 APPLICATION OF DIFFERENT SPECTROSCOPIC METHODS TO THE SOLUTION OF PROBLEMS IN CHEMICAL ANALYSIS. Volumes I and II. 16th international spectroscopy conference, Heidelberg, Germay, October 4–19, 1971. London; Adam Hilger Ltd. (1971). vp. (In several languages). (CONF-711015–(Vols. 1 and 2).

From 16th international conference on spectroscopy; Heidelberg, Federal Republic of Germany (F. R. Germany) (4 Oct 1971).

Abstracts were prepared for 8 of the 167 papers presented in Volumes I and II. (UK)

For abstracts of individual papers see: 24312–24316, 24337, 24346, and 25629.

24312 PRECONCENTRATION AND SPECTROCHEMICAL DETERMINATION OF TRACE IMPURITIES IN NUCLEAR MATERIALS. Berthelot, C. H.; Di Branco, G.; Herrmann, S.; Mencarelli, T. (Commission of the European Communities, Geel, Belg.). pp 55-63 of Application of Different Spectroscopic Methods to the Solution of Problems in Chemical Analysis. Vols. I and II. London; Adam Hilger Ltd. (1971). (In French).

From 16th international conference on spectroscopy; Heidelberg, Federal Republic of Germany (F. R. Germany) (4 Oct 1971). See CONF-711015-(Vols. 1 and 2).

Existing methods of preconcentration are used and have been further developed to enable materials of nuclear or metallurgical interest (heavy water, Li, C, Fe, Cu, U, and transuranium elements) to be analyzed by emission spectroscopy for elements present at concentrations <1 ppM (in particular, B, Be, Cd, Cr, Dy, Eu, Gd, Li, Mo, Nb, Ru, Sb, Sm, Ta, Ti, V, W, and Zr). The methods are described briefly, together with the spectrographic equipment and operating conditions. The limits of detection are tabulated for each method of preconcentration employed. (UK)

24313 MASS SPECTROMETRIC ANALYSIS OF HIGH BURN-UP COATED REACTOR FUEL PARTICLES. den Boef, P. (Reactor Centrum Nederland, Petten); Joon, K.; de Wit, R.,: Stijfhoorn, D.; Haaland, J. pp 154-160 of Application of Different Spectroscopic Methods to the Solution of Problems in Chemical Analysis. Vols I and II. London; Adam Hilger Ltd. (1971).

From 16th international conference on spectroscopy; Heidelberg, Federal Republic of Germany (F. R. Germany) (4 Oct 1971). See CONF-711015-(Vols. 1 and 2).

Particles of plutonium dioxide, coated with layers of pyrocarbon and silicon carbide, become highly radioactive in a reactor and necessitate the use of remote handling techniques. The technique of crushing these particles is briefly described, together with the methods for chemical extraction of the minute quantities of elements produced by a given fission. The isotopic composition and the absolute quantities of Zr, Mo, Ru, Cs, Nd, Sm, Eu, and Pu were determined by mass spectroscopy. A description of the preparation and measuring techniques is given. (UK)

24314 EMISSION SPECTROSCOPIC DETERMINATION OF ISOTOPES IN NUCLEAR FUELS. Mainka, E.; von Baeckmann, A. (Gesellschaft fuer Kernforschung mbH, Karlsruhe, Ger.). pp 220-225 of Application of Different Spectroscopic Methods to the Solution of Problems in Chemical Analysis. Vols. I and II. London; Adam Hilger Ltd. (1971). (In German).

From 16th international conference on spectroscopy; Heidelberg, Federal Republic of Germany (F. R. Germany) (4 Oct 1971). See CONF-711015-(Vols. 1 and 2).

In the control of fissile material it is of interest to know whether the emission spectroscopic isotope analysis constitutes an adequate alternative of mass spectrometry with respect to the accuracy that can be achieved. Under certain conditions, the emission spectroscopic method is faster, cheaper and, evidently, it lends itself easier to automation. Measuring equipment is described with emphasis being laid on line separation for direct measurement. The choice of analytic lines is discussed in detail. Special attention is given to the assay of the ^{241}Pu, since contradictory information is provided in literature by Orrell and Veyvoda. Results allow the conclusion that by means of arc excitation the determination of ^{241}Pu is not possible. The mutual influencing of intensity ratios of neighbouring lines with known half widths is indicated. Arc excitation is compared to hollow cathode excitation. Following a description of the working conditions the accuracies of measurements achieved through arc excitation are stated. (auth)

24315 PHYSICAL-CHEMICAL STUDIES ON A DC ARC AT HIGH HELIUM PRESSURES. A Contribution to the Identification of Fuel Element Spheres from a High Temperature Reactor. Nickel, N.; Keintzel, G. (Kernforschungsanlage, Juelich, Ger.). pp 247-252 of Application of Different Spectroscopic Methods to the Solution of Problems in Chemical Analysis. Vols. I and II. London; Adam Hilger Ltd. (1971). (In German).

From 16th international conference on spectroscopy; Heidelberg, Federal Republic of Germany (F. R. Germany) (4 Oct 1971). See CONF-711015–(Vols. 1 and 2).

Results are reported of preliminary studies with regard to the pressure influence on a d.c. arc. The discharge gas is helium, the pressure of which varies between 1 atm and 50 atm. The increase of the arc voltage with pressure is shown: a linear dependence of the voltage on the pressure can be seen. This dependence was verified by experimental results. The current-voltage characteristics in the He-atmosphere with the pressure as parameter are pointed out. These characteristics differ in varying the electrode-materials and -forms. For example the curves for a W-cathode for 5 atm and above are characterized by a minimum followed by a strong increase, depending on the height of the He-pressure. The sharp rise at high pressures can be related with a spontaneous vaporization of the carbon of the anode. The section of a spectral-plate with the carbon line at CI 2478 Å being increased with He-pressure is given. The different breadths for 10 atm and 40 atm are demonstrated by a photometer recording. The line width as a function of the He-pressure is represented. The linearity up to 35 atm (1 sec exposure) is a proof for the impact-broadening theory. The temperature of the arc under 40 atm He-pressure was measured to 12000 and 14000°K by means of two spectroscopic methods. (auth)

24316 STUDY OF CHEMICAL REACTIONS IN THE ELECTRODE CAVITY WITH THE SPECTROGRAPHIC DETERMINATION OF IMPURITIES IN UF_4 USING ZnO AS A URANIUM EXCITATION SUPPRESSOR. Alvarez–Alduan, F.; Capdevila, C.; Roca, M. (Junta de Energia Nuclear, Madrid). pp 259-263 of Application of Different Spectroscopic Methods to the Solution of Problems in Chemical Analysis. Vols. I and II. London; Adam Hilger Ltd. (1971).

From 16th international conference on spectroscopy; Heidelberg, Federal Republic of Germany (F. R. Germany) (4 Oct 1971). See CONF-711015–(Vols. 1 and 2).

As a result of a study of various compounds used to suppress uranium excitation it has been established that ZnO permits the direct determination of boron and silicon in UF_4 by means of a 10 A d.c. arc using Scribner-type electrodes. The chemical reactions which occur in the electrode cavity and retard the volatilisation of uranium were studied. Volatilisation-excitation characteristics were plotted for uranium in UF_4 and for uranium and zinc in the mixtures UF_4–ZnO, U_3O_8–ZnF_2, and U_3O_8–ZnO. The electrode residues were analyzed by x-ray diffraction following excitation of samples for varying times as determined from these curves. The flourine content in the residue obtained after exciting the mixture UF_4–ZnO at various temperatures was determined chemically. It is considered that the delayed

volatilisation of uranium in UF_4 when ZnO is added can be explained as a consequence of the formation of UO_2 in the electrode cavity and a compound of flourine, uranium and zinc, both less volatile than UF_4. (UK)

24317 SPECTROPHOTOMETRIC DETERMINATION OF MOLYBDENUM(VI) BY SOLVENT EXTRACTION WITH TIRON IN THE PRESENCE OF ZEPHIRAMINE AND ITS APPLICATION TO THE DETERMINATION OF MOLYBDENUM IN IRON AND STEEL. Nakatani, M. (Sasebo Technical Coll., Nagasaki). Jap. Anal.; 21: No. 12, 1624-1629(Dec 1972). (In Japanese).

It was found that molybdenum reacts with tiron in the presence of zephiramine to give a yellow precipitate (molybdenum–tiron–zephiramine ternary complex) that has an absorption maximum at 390 nm when extracted into chloroform at pH 8.0. This spectrum of the complex may be used in the spectrophotometric determination of molybdenum, but such ions as iron(III), vanadium(V), and perchlorate interfere seriously with the determination. To prevent the interference of these ions, molybdenum was extracted into chloroform as α-benzoinoxime complex, which then reacted with tiron in the presence of zephiramine to form the molybdenum–tiron–zephiramine ternary complex in chloroform. This reaction was applied to the determination of molybdenum in iron and steel, and results were satisfactory. The addition of L-ascorbic acid solution in extracting the complex did not effect the determination of molybdenum, but the coexistence of tungsten interfered with the determination, so in the case of tungsten-bearing steel, it was necessary to remove tungsten prior to the extraction of the molybdenum complex. (auth)

24318 STEELS: DETERMINATION OF Mo, Cr, AND P. Jean, M. Analusis; 1: No. 5, 358-361(Oct 1972). (In French).

Spectrophotometric techniques for determining Mo, Cr, and P in steels are presented. The methods adopted for the three elements are respectively: the formation of a Cr blue-black dye (for Mo); the formation of a complex between Cr and complexone-III (for Cr); the formation of a complex with Mo blue reduced in the presence of Bi (for P). (France)

24319 SIMULTANEOUS DETERMINATION OF Mo AND W IN U AND URANIFEROUS SOLUTIONS. Toussaint, C.; Cattin, G. (CEA, Pierrelatte, France). Analusis; 1: No. 5, 347-351 (Oct 1972). (In French).

The spectrophotometric determination of Mo and W in U and uraniferous solutions can be effected by colorimetry after separating U from Mo and W cations by TBP extraction in dodecane. Molybdenum is subsequently reduced and complexed with thiocyanate before the extraction and determination are performed. Tungsten, which remains in the aqueous phase, is reduced with Ti(III) and complexed with the thiocyanate before extraction and determination. The limiting sensitivity, the sensitivity, and the reproducibility of the determinations are presented. (France).

24320 FLUORIMETRIC METHOD FOR THE DETERMINATION OF URANIUM IN NATURAL WATERS. Danielsson, A.; Roennholm, B.; Kjellstroem, L. E.; Ingman, F. (Sveriges Geologiska Undersoekning, Stockholm). Talanta; 20: No. 2, 185-192(Feb 1973).

A method is described for the fluorimetric determination of uranium in natural waters. The limit of detection is 0.3 ppM. Ion-exchange is used to preconcentrate the uranium by a factor of 22 and separate it from quenching ions in the sample. The fluorescence is measured in a medium that is 1.35M in both sulphuric and phosphoric acids. The uranyl ions are excited by radiation of wavelength 280 nm and bandwidth 40 nm. The emitted signal is scanned from 470 to 510 nm. After spiking of the sample solution with a small volume of standard uranium solution, the fluorescence signal is scanned again and the uranium content of the sample calculated from the two readings. The coefficient of variation is 8.5% for determinations of U in a synthetic water sample having a uranium content of 1.9 ppM. Destruction of organic matter in the eluates gives 0.1 ppM detection limit. (auth)

24321 ACQUISITION AND AUTOMATIC PROCESSING OF MASS SPECTROMETRY DATA. Application to the Analysis of Hydrogen Isotopes and Gaseous Impurities. Froment, G. (Centre d'Etudes, Montrouge, France). Analusis; 1: No. 5, 352-357(Oct 1972). (In French).

An automated system for the analysis of hydrogen isotopes and impurities (O_2, N_2, Ar, CO_2, and ^3He), which utilizes a mass spectrometer, is presented. The rapidity of the method enables a three-fold increase in the number of analyses performed to be achieved. The advantages and the disadvantages of the method are discussed. (France)

24322 DETERMINATION OF THE ISOTOPIC COMPOSITION OF FISSION Cs IN Na. Lucas, M.; Lecomte, T. (CEN de Saclay, Gif-sur-Yvette, France). Analusis; 1: No. 5, 340-346(Oct 1972). (In French).

The isotopic dilution method can be used to determine the isotopic composition of the fission Cs present in the Na coolant of fast neutron reactors (Rapsodie). The chemical treatment prior to isotopic analysis is described together with the tracer and calibration methods used. The thermoionization mass spectrograph analysis conditions are defined. A correction procedure for contamination due to natural Cs was developed. Concentrations of about 5×10^{-10} g of Cs/g of Na can be measured with an accuracy of about ±2%. (France)

24323 REACTION OF LANTHANUM WITH REAGENT ARSENAZO-p-NO_2. Perisic-Janjic, N. U.; Muk, A. A.; Canic, V. D. (Faculty of Tech., Novi Sad, Yugoslavia). Anal. Chem.; 45: No. 4, 798-801(Apr 1973).

It was shown that arsenazo-p-NO_2 can be successfully used for spectrophotometric determination of lanthanum. The reaction of lanthanum with arsenazo-p-NO_2 produces a complex of high sensitivity. At pH 4.5, a stable complex of type I only is produced. Arsenazo-p-NO_2 seems to be bound to lanthanum in a complex of type I via the o-arsono-o-oxyazo group and is characterized by absorption bands at about 600 to 670 mm. At a lower pH, the complex of type I changes into a complex of type III, its formation being described by a first order reaction. However, this complex of type III disintegrates further with time and finally disappears causing the formation of precipitate. (DHM)

24324 INTERELEMENT EFFECTS IN THE FLAME: SPECTROSCOPIC DETERMINATION OF ALUMINUM, MOLYBDENUM, AND VANADIUM IN A NITROUS OXIDE–ACETYLENE FLAME FORMED ON A CIRCULAR SLOT BURNER. West, A. C.; Kniseley, R. N.; Fassel, V. A. (Ames Lab., Iowa). Anal. Chem.; 45: No. 4, 815-816(Apr 1973).

Comparison of results obtained on the effect of concomitants on the flame atomic absorption and emission of Al, Mo, and V with those reported by R. M. Dagnall, G. F. Kirkbright, T. S. West, and R. Wood, Anal. Chem., 42, 1029 (1970) shows that: (a) depression or no effect in those instances where Dagnall et al. reported 100 to 2900% enhancements; (b) either depressions or smaller enhancements when the Dagnall et al. reported percentage enhancements below 100%; and (c) a greater percentage depression when Dagnall et al, reported depressions. The inability to confirm the unusually large enhancement effect reported by Dagnall et al. suggests that their data have limited transferability even if the experimental conditions are similar. (DHM)

24325 RAPID MACRODETERMINATION OF OXYGEN IN URANIUM OXIDES BY GRAPHITE REDUCTION. Holt, B. D. (Argonne National Lab., IL). Anal. Chem.; 45: No. 4, 648-654 (Apr 1973).

The need for a fast direct method of determining oxygen in metal oxide nuclear fuels, by which simpler indirect methods may be checked, is met by a modification of the graphite-reduction method. Using a newly designed reaction chamber, the oxygen of 0.1-gram samples of uranium oxide is converted quantitatively to CO in less than 10 minutes by heating in a sealed graphite capsule at 2400°C and directing the effluent carrier gas stream through a bed of graphite chips at ~2400°C. The graphite capsule is remotely manipulated into and out of the graphite furnace without opening the reaction chamber. The CO is oxidized to CO_2 and measured in a high capacity capillary manometer. The relative error in the oxygen data is about 0.2%. The analysis of a weighed encapsulated sample can be completed in one-half hour. (auth)

24326 SIGNAL AVERAGING METHOD FOR HIGH RESOLUTION MASS SPECTRAL MEASUREMENT OF NITROGEN-15. Haddon, W. F.; Lukens, H. C.; Elsken, R. H. (Western Regional Research Lab., Berkeley, CA). Anal. Chem.; 45: No. 4, 682-686 (Apr 1973).

By averaging repetitive electric sector scans on a double-focusing mass spectrometer, accurate abundance ratios of stable isotopes can be obtained on microgram samples using the isotopic multiplets at a single nominal mass. The method is useful for ^{15}N measurement for most nitrogen-containing organic compounds, and for ^{15}C measurement in compounds which also contain nitrogen. Repetitive scanning increases the accuracy of measurement under conditions of changing sample concentration, thus permitting accurate isotope ratio determination on samples admitted by direct probe or chromatographic inlets. An application to the measurement of $^{15}N_2$-enriched creatinine is given. A limit of detection of 0.002 atom per cent excess $^{15}N_2$ at the 95% confidence level is demonstrated. (auth)

Radiometric and Radiochemical Procedures

Refer also to abstracts 24332, 24345, 24609, 24648, 24690, 24717, and 24724.

24327 (CONF-720404(Vol.4)) PROCEEDINGS OF THE INTERNATIONAL CONFERENCE ON INNER SHELL IONIZATION PHENOMENA AND FUTURE APPLICATIONS, ATLANTA, GEORGIA, APRIL 17–22, 1972. Fink, R. W.; Manson, S. T.; Palms, J. M.; Rao, P. V. (eds.) (Georgia Inst. of Tech., Atlanta; Emory Univ., Atlanta, Ga). Jan 1973. 204p. Dep. NTIS.

Separate abstracts were prepared for seven of the twelve papers presented. An abstract of one of the papers appeared previously in NSA as 26: 28213. (DHM)

24328 (CONF-720404(Vol.4), pp 2218-2236) PRACTICAL PROBLEMS IN CHEMICAL ANALYSIS USING ENERGY DISPERSIVE X-RAY EMISSION SPECTROMETRY. Rhodes, J. R. (Columbia Scientific Industries, Austin, TX). Jan 1973.

From International conference on inner shell ionization phenomena and future applications; Atlanta, Georgia (17 Apr 1972).

In proceedings of the international conference on inner shell ionization phenomena and future applications.

X-ray emission analysis using energy dispersion or energy discrimination (i.e., filters) is reviewed. The accompanying bibliography contains 115 references covering the period 1970 to 1972. The status of practical applications is discussed with emphasis on some problems in the way of further development. (auth)

For abstracts of individual papers see: 24328–24330, 25624, 25717, 26476, and 26654.

24329 (CONF-720404(Vol.4), pp 2252-2259) FUTURE DEVELOPMENTS IN ELECTRON PROBE MICROANALYSIS. Heinrich, K. F. J. (National Bureau of Standards, Washington, DC).

From International conference on inner shell ionization phenomena and future applications; Atlanta, Georgia (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

The principles and past history of the electron probe microanalyzer are briefly reviewed. A projection of improvements expected in the foreseeable future is attempted. The areas of probable development are determined, not only by feasibility, but also by the projected needs of the analyst. (auth)

24330 (CONF-720404(Vol.4), pp 2260-2272) MUONIC X-RAYS: A FUTURE ANALYTICAL TOOL. Taylor, M. C. (Columbia Scientific Industries, Austin, TX). Jan 1973.

From International conference on inner shell ionization phenomena and future applications; Atlanta, Georgia (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

Muonic x-rays, which result from the capture of negative muons into orbit around nuclei to form "muonic atoms," may be a valuable analytical tool. The x-ray transition energies are about 200 times the energies from electronic transitions—the carbon K_α energy is of the order of 75 keV. Thus, muonic x-rays from light elements have considerable penetrating power and can escape from bulk samples. Experimental results are presented which demonstrate the potential of this technique for observing elements in the range from carbon to calcium in biological and geological samples. The radiation dose from these measurements is quite low making this a valuable method of analysis in applications where precious or live materials are involved, for example, in vivo diagnostic studies and analysis of extra terrestrial materials. Advantages and disadvantages of this technique with respect to present methods of analysis are discussed. (auth)

24331 (CONF-721010-50) RELATIVE SENSITIVITY AND ACCURACY OF NaI(Tl) AND Ge(Li) DETECTORS FOR MINOR COMPONENTS. Lucas, H. F. Jr.; Edgington, D. N. (Argonne National Lab., Ill.). 1972. 8p. Dep. NTIS $3.00.

From International conference on modern trends in activation analysis; Saclay, France (2 Oct 1972).

A mixture of ^{233}Pa, ^{140}La, ^{82}Br, ^{64}Cu, ^{72}Ga, ^{60}Co, and ^{24}Na of known disintegration rates was counted on a NaI(Tl) and a large Ge(Li) detector. Both systems detected ^{233}Pa when present at 0.2%, and accurate results were observed for ^{233}Pa, ^{140}La, and ^{60}Co when present at greater than 0.5% of the total disintegration rate. The accuracy of the results from either system was not significantly different since the mean ratio of the observed to true results was 0.99 ± 0.05 and 1.06 ± 0.06, respectively. However, equal sensitivity and accuracy were achieved only when the counting interval for the germanium system was 1000 min, or 60 to 600 times that for sodium iodide. (auth)

24332 (KFK-1679) CONTINUOUS MEASUREMENT OF ^{85}Kr IN PRESENCE OF ^{41}Ar. Edelhaeuser, H.; Fessler, H.; Michel, H. (Kernforschungszentrum, Karlsruhe (West Germany)). Nov 1972. 14p. (In German). Dep. NTIS (U. S. Sales Only) $3.00.

A method for measuring the activity of ^{85}Kr in air in the presence of ^{41}Ar is described. The detector system consists of three large area gas flow counters arranged as a sandwich. The two counters, which are provided for the measurement of the ^{85}Kr- and ^{41}Ar-β particles are separated by an absorber foil to get different sensitivities for the ^{85}Kr- and ^{41}Ar-β radiation. If there is no gamma-background from ^{41}Ar the lower detection limit for ^{85}Kr is 1.4×10^{-8} Ci/m^3. If ^{41}Ar-γ-radiation from the environment can enter the detectors a modified compensation must be used, so that both gamma- as well as beta-radiation from ^{41}Ar will be compensated. The lower detection limit will then increase to 12.5×10^{-8} Ci/m^3. (auth)

24333 (KFK-1745) GAMMA RESONANCE FLUORESCENCE: METHOD FOR THE NONDESTRUCTIVE DETERMINATION OF ^{235}U. Weitkamp. C. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Angewandte Kernphysik). Feb 1973. 8p. (In German). Dep. NTIS (U. S. Sales Only) $3.00.

The level diagram of ^{235}U was searched for states that are depopulated by strong γ transitions to the ground state and whose energy is sufficiently closely matched by a γ ray from a radioactive source so γ resonance fluorescence can be expected. Few candidates were found because (a) errors of level energies of ^{235}U amount to 0.1 to 2 keV as compared to thermal line broadening of about 1 eV, and (b) lifetimes for the computation of the expected cross section have neither been measured, nor have the quantum numbers for their calculation been determined for the majority of states. The most promising candidate is the $J^\pi K = 5/2 + 5/2$ level for which the deexciting γ ray is quoted to have an energy of (1115.6 ± 0.3) keV, and a source of 245 d–^{65}Zn with a γ ray of (1115.518 ± 0.025) keV. The experiment performed with the source at room temperature did not yield a positive result; a similar measurement is proposed in which use is made of Doppler broadening by Coulomb fragmentation. (auth)

24334 RAPID METHOD FOR THE DETERMINATION OF RADIOACTIVE CESIUM ISOTOPES IN WATER. Janzer, V. J. J. Res. U. S. Geol. Surv.; 1: No. 1, 113-115(1973).

Radioactive cesium in water is concentrated by ion-exchange on finely divided ammonium hexacyanocobalt ferrate (NCFC) and then determined by beta counting. No carrier is added, and the method can be used to determine beta-emitting cesium isotopes at the 10-pCi/l level using a 100-ml sample. Five samples can be prepared for counting in approximately 3 hours, and the method is applicable to fresh and saline waters. (auth)

24335 METHOD OF MEASURING ALPHA ACTIVITY OF DUSTS CONTAINING URANIUM AND THORIUM. Andralojc, T. (Dept. of Radiological Protection, Szczecin, Poland); Matenko, J.; Slapa, M. Nukleonika; 17: No. 10, 537-546(1972).

A method is described that can be used to determine the activity of phosphorites contaminating the air with dust in the loading area and in phosphate fertilizer plants. The method consists of electrolytic precipitation of uranium and thorium in a thin layer which is then α counted. Results show that the α activity of phosphorites comes from natural uranium isotopes and their decay products. (DHM)

24336 AGING, TOTAL BODY POTASSIUM, FAT-FREE MASS, AND CELL MASS IN MALES AND FEMALES BETWEEN AGES 18 AND 85 YEARS. Novak, L. P. (Mayo Clinic and Mayo Foundation, Rochester, MN). J. Gerontol.; 27: No. 4, 438-443 (Oct 1972).

Determinations of total body potassium by counting naturally radioactive ^{40}K in the whole-body counter were made in 215 adult men and 305 adult women whose ages ranged from 18 to 85 in years. In general, total body potassium decreased with age in men from 56.1 mEg/kg to 43.4 mEg/kg and in women from 45.6 mEg/kg tp 37.6 mEg/kg. At all ages, men had significantly more relative amounts of total-body potassium than did women. (MCG)

24337 AUTOMATIC CONTROL OF NUCLEAR FUELS BY X-RAY FLUORESCENCE ANALYSIS. von Baeckmann, A.; Neuber, J.; Gantner, E. (Kernforschungszentrum, Karlsruhe, Ger.). pp 176-181 of Application of Different Spectroscopic Methods to the Solution of Problems in Chemical Analysis. Vols. I and II. London; Adam Hilger Ltd. (1971). (In German).

From 16th international conference on spectroscopy; Heidelberg, Federal Republic of Germany (F. R. Germany) (4 Oct 1971). See CONF-711015– (Vols. 1 and 2).

For simplification of the control of nuclear fuels, an automatic system is presently under development at the Karlsruhe Nuclear Research Center for the determination of uranium and plutonium in solutions of irradiated and unirradiated nuclear fuels on the basis of x-ray fluorescence analysis. This method seems particularly suitable because it is hardly disturbed by the presence of spurious elements, can be applied to highly radioactive solutions independent of the chemical state of the element to be determined, can be automated relatively easily, and has a degree of accuracy which is sufficient for purposes of nuclear safeguards. The accuracies and reproducibilities attained are tabulated. The design of the system consists of an automatic sample preparation stage contained in a glove box whose physical layout is shown.

The flowsheet, the tabulator controlled spectrometer (Siemens SRS-1), and a computer program for calculation of the analytical results from the measured data of the standard samples, and the analytical samples are indicated. The system will be able to perform four analyses an hour in a fully automatic way. After every fifty analyses the magazines for the non-returnable pipettes and beakers must be refilled. In 1972, the system is to be improved and tested with highly radioactive samples. (auth)

24338 TRACE ELEMENT DETERMINATION WITH SEMICONDUCTOR X RAY SPECTROMETERS. Giauque, R. D.; Goulding, F. S.; Jaklevic, J. M.; Pehl, R. H. (Univ. of California, Berkeley). Anal. Chem.; 45: No. 4, 671-681(Apr 1973).

A method of obtaining high sensitivity and accuracy in x-ray fluorescence analysis using semiconductor detector spectrometers is discussed. Mono-energetic exciting radiation is employed to generate characteristic x-rays from trace elements in thin, uniform specimens. Corrections for absorption effects are determined; enhancement effects are omitted as they are negligible for many thin specimens. A single element thin-film standard is used to calibrate for the x-ray geometry, and theoretical cross sections and fluorescent yield data are employed to relate the x-ray yields for a wide range of elements to the thin-film standard. Various corrections which affect the accuracy of the method are discussed including the method for determining x-ray spectral background. Results obtained in the analyses of biological and geological specimens, and of air particulate filters are reported. Using a single excitation energy, the concentrations of more than fifteen trace elements may be simultaneously determined during a fifteen-minute interval for concentrations of 1 ppM or less. This corresponds to less than 10 ng/cm^2 on air particulate filters. (auth)

24339 IMPROVED METHOD FOR THE DISCRIMINATION BETWEEN BIOGENIC AND SYNTHETIC ACETIC ACID WITH A LIQUID SCINTILLATION COUNTER. Kaneko, T. (Inst. of Physical and Chemical Research, Saitama, Japan); Ohmori, S.; Masai, H. J. Food Sci.; 38: No. 2, 350-353(Feb 1973).

Results presented here show that it is possible to estimate the carbon-14 content of acetate in a given vinegar within 1 to 2% error in a single experiment. Replicate and/or repeated assays naturally give more reliable data. Thus, the ratio of synthetic to total acetate may be determined with a few percent deviation. (auth)

Separation Procedures

24340 EXTRACTION OF RARE EARTH ELEMENTS OF THE CERIUM SUBGROUP INTO TRIBUTYL PHOSPHATE FROM CHLORIDE-NITRATE SOLUTIONS. Klimenko, M. A.; Kotlyarov, R. V.; Mikhailichenko, A. I.; Bogdanov, V. P. J. Appl. Chem. USSR (Engl. Transl.); 45: No. 8, 1839-1844(Aug 1972).

Translated from Zh. Prikl. Khim.; 45: No. 8 1762-1768(Aug 1972).

Study of extraction of rare earth elements from mixed chloride–nitrate solutions into tributyl phosphate showed that at low nitrate-ion concentrations mixed chloride–nitrate solvates of the composition $[Ln(NO_3)_iCl_{3-i}\cdot qTBP]_{org}$ are probably extracted. At moderate and high concentrations of nitrate ions the composition of the solvates, $[Ln(NO_3)_3\cdot 3TBP]_{org}$, is the same as in extraction from pure nitrate solutions. Study of the influence of salting-out agents (nitrates of ammonium, lithium, and aluminum) on extraction of RE from mixed chloride–nitrate solutions showed that these nitrates form the series $NH_4NO_3 < Al(NO_3)_3 < LiNO_3$ in order of increasing effectiveness of salting-out. The coefficients of separation, β, for elements of the cerium subgroup, determined in extraction of rare-earth elements from chloride solutions (with 5N aluminum nitrate as the salting-out agent), were: Ce–La, 2.1; Pr–Ce, 1.5; Nd–Pr, 1.5; Sm–Nd, 1.6; Nd–Gd, 1.6. The lower values of β in chloride–nitrate solutions in comparison with pure nitrate solutions are explained in relation to the physicochemical state of lanthanide ions in these systems. (auth)

24341 EXTRACTION OF THIOCYANATES OF LANTHANIDE ELEMENTS INTO TRIBUTYL PHOSPHATE IN PRESENCE OF 8-HYDROXYQUINOLINE. Golub, A. M.; Au Van Long (Kiev State Univ.). J. Appl. Chem. USSR (Engl. Transl.); 45: No. 8, 1853-1858(Aug 1972).

Translated from Zh. Prikl. Khim.; 45: No. 8, 1776-1781(Aug 1972).

The extraction of lanthanides of the cerium group into tributyl phosphate (TBP) in the presence of thiocyanate ions and 8-hydroxyquinoline (oxine) was studied. A mixture of tributyl phosphate and oxine is more effective than either solvent separately in extraction of thiocyanates of the lanthanide elements. Maximum extraction corresponds to a 3:2 ratio of the oxine and thiocyanate-ion concentrations. It was established by graphical analysis that the extracted complexes have the composition $Ln(NCS)_2Ox(HOx)_2(TBP)_2$. The distribution coefficients of lanthanides in the form of mixed complexes increase with the atomic numbers of the elements, with a decrease in the case of gadolinium. Spectroscopically pure lanthanum can be obtained from a mixture of lanthanides of the cerium group by four-stage countercurrent extraction. The same method was used for obtaining a neodymium fraction with neodymium contents from 65 to 95.5%, and a fraction consisting of samarium, europium, and gadolinium. (JGB)

24342 PROCESS OF SEPARATING YTTRIUM AND LANTHANUM THROUGH LUTETIUM FROM MIXTURES OF SUCH ELEMENTS. Greinacher, E.; Fischer, W.; Daehne, M. U. S. Patent 3,715,424. 6 Feb 1973. Priority date 8 Nov 1967, Austria. 6p.

A process is described for separating at least two elements from a mixture containing rare earths and yttrium by distributing the thiocyanates of the elements between an aqueous phase and an organic solvent phase. The concentration of the elements in the aqueous phase is at least 1.5 gram-atoms per liter, but preferably between 2 gram-atoms per liter and the saturation limit. The thiocyanate concentration in the aqueous phase is between 0.01 to 3 mole per liter. (Official Gazette)

Inorganic, Organic, and Physical Chemistry

Chemical and Physicochemical Properties

Refer also to abstracts 24487 and 26290.

24343 (BARC-628, pp 141-149) REACTOR CHEMISTRY. 1972.

In the chemical development work on the molten salt breeder reactor concept utilizing plutonium, the solubility of PuF_3 was determined in the ternary mixture $LiF-BeF_2-ThF_4$ of different compositions in the temperature range of 500 to 800°C and found to be above 0.7 m/o at all concentrations and temperatures. Similarly the solubility of PuF_3 in the binary mixture $LiF-ThF_4$ of different compositions was determined in the temperature range of 500 to 800°C. An attempt was made to correlate the solubility of PuF_3 with the base salt composition. (auth)

24344 (LF-45, pp 13-20) PRODUCTION OF SUBMICRON METAL OXIDE AEROSOL PARTICLES FROM THEIR THD COMPOUNDS BY VAPORIZATION-DEGRADATION METHODS. Kanapilly, G. M.; Larsen, T. B.; Fogel, G. R. Nov 1972.

In fission product inhalation program.

An improved procedure was developed for producing submicron aerosol particles of rare earth elements such as may be accidentally released in nuclear operations. The Y and La compounds of 2,2,6,6 tetramethyl-3,5-heptanedione [$Y(THD)_3$ and $La(THD)_3$] were used to produce submicron aerosol particles of mass median diameters <0.3 μm. Two methods were used in these studies. The first consisted of vaporization of the $Y(THD)_3$ or $La(THD)_3$ and direct heat degradation of the vapor. This procedure yields chains of extremely small particles. The second method consisted of vaporization, condensation, revaporization, subsequent condensation and heat degradation. This method provided distinct submicron size particles, ranging from 0.3 to <0.1 μm. Several factors which affect size distribution were investigated. (auth)

24345 INVESTIGATION OF THE ADSORPTION OF SULFUR ON PLATINUM FOILS BY MEANS OF A TRACER METHOD. Seidl, G.; Bechtold, E. (Univ., Innsbruck). Z. Phys. Chem. (Frankfurt); 81: No. 1-4, 213-221(Oct 1972). (In German).

An apparatus is described for investigation of the adsorption of labeled sulfur (^{35}S) on compact samples. The amount of sulfur adsorbed can be measured directly on the surface of the adsorbent by using beta scintillation counting. Sulfur was measured by this method on polycrystalline platinum foils at 270, 325, and 380°C and at 7×10^{-10} to $\sim10^{-8}$ atm. (MCG)

24346 HIGH-TEMPERATURE REACTIONS IN SYSTEMS CONSISTING OF GRAPHITE, SILICON CARBIDE, AND THIRD COMPONENT (MgO, Al_2O_3, B_4C, V_2O_5, AND NaF). Rajic, S. (Zavod za Nuklearne Sirovine, Belgrade). pp 270-273 of Application of Different Spectroscopic Methods to the Solution of Problems in Chemical Analysis. Vols. I and II. London: Adam Hilger Ltd. (1971).

From 16th international conference on spectroscopy; Heidelberg, Federal Republic of Germany (F. R. Germany) (4 Oct 1971). See CONF-711015–(Vols. 1 and 2).

A study was made of the evaporation of elements from electrodes at different controlled temperatures. High-temperature reactions were also investigated in systems composed of graphite, α-SiC, and a third component consisting of MgO, Al_2O_3, B_4C, V_2O_5, and NaF. This was done by x-ray diffractometry. It was estab-

lished that new phases are formed at the same temperature as that at which the elements begin to evaporate. Such new phases were found in all systems investigated. Not all the phases were identified, however. (UK)

24347 ENTHALPY OF FORMATION OF DISODIUM ACETYLIDE AND OF MONOSODIUM ACETYLIDE A 298.15 K, HEAT CAPACITY OF DISODIUM ACETYLIDE FROM 5 TO 350 K, AND SOME DERIVED THERMODYNAMIC PROPERTIES. Johnson, G. K.; Van Deventer, E. H.; Ackerman, J. P.; (and others) (Argonne National Lab., IL). J. Chem. Thermodyn.; 5: No. 1, 57-71(Jan 1973).

The enthalpies of reaction of Na_2C_2 and of $NaHC_2$ with water were measured, and the standard enthalpies of formation of Na_2C_2 and $NaHC_2$ at 298.15°K were determined to be (4.80 ± 0.40) and (23.10 ± 0.27) $kcal_{th}$ mol^{-1}, respectively. The heat capacity of Na_2C_2 was measured from 5 to 350°K. The following values were obtained for Na_2C_2(c) at 298.15°K: heat capacity at constant pressure: $C_p^0(298.15°K) = (90.98 \pm 0.27)$ J K^{-1} mol^{-1}; entropy: $S^0(298.15°K) = (111.24 \pm 0.33)$ J K^{-1} mol^{-1}; enthalpy: $\{H^0(298.15°K) - H^0(0)\} = (17389 \pm 52)$ J mol^{-1}; Gibbs energy divided by temperature: $\{G^0\{298.15°K) - H^0(0)\}/298.15°K = -(52.92 \pm 0.16)$ J K^{-1} mol^{-1}. The standard Gibbs energy of formation, ΔG_f°, of Na_2C_2 at 298.15°K is (5.02 ± 0.41) $kcal_{th}$ mol^{-1}. The standard Gibbs energy of formation at higher temperatures was estimated from an extrapolation of the heat capacity curve. The concentration of Na_2C_2 in liquid sodium in equilibrium with graphite was calculated from ΔG_f° and the solubility of Na_2C_2 in liquid sodium, and a comparison was made with experimental values for the solubility of graphite in liquid sodium. The comparison indicates that dissolved Na_2C_2 can be an important species, and possibly the only species, formed when graphite dissolves in liquid sodium. It is further concluded that models based on dissolved Na_2C_2 for the transport of carbon in liquid-sodium-cooled reactors are thermodynamically possible. (auth)

Isotope Effects

Refer also to abstract 24492.

24348 MICROWAVE STUDIES ON THE STRUCTURE AND HYDROGEN BONDING OF 6-HYDROXY-2-FORMYLFULVENE. Pickett, H. M. (Harvard Univ., Cambridge, MA). J. Amer. Chem. Soc.; 95: No. 6, 1770-1774(21 Mar 1973).

The microwave spectrum of 6-hydroxy-2-formylfulvene was studied in order to determine the symmetry of the molecule and the nature of its hydrogen bond. The nuclear spin statistics observed for the normal isotopic species and the species with a deuterated hydroxyl group in ground and vibrationally excited states put a lower limit of 2×10^{12} sec^{-1} for any rate for tautomerization between asymmetric forms. The data are consistent with a model in which the molecule has C_{2v} symmetry with the proton centered in the hydrogen bond. An anomalous deuterium isotope effect on the moments of inertia indicates the O–H stretching motion is mixed with O–O symmetric stretching motion to yield changes in the O–O distance upon deuteration similar to that observed previously for other systems using x-ray techniques. (auth)

24349 INFRARED STUDIES OF MATRIX ISOLATED SPECIES IN THE HYDROGEN–BORON–NITROGEN SYSTEM. Lory, E. R.; Porter, R. F. (Cornell Univ., Ithaca, NY). J. Amer. Chem. Soc.; 95: No. 6, 1766-1770(21 Mar 1973).

Infrared spectra of the 1216-Å photolysis products of ammonia–borane (H_3NBH_3) and deuterated ammonia–borane in rare gas matrices indicate that the major product is imidoborane (HNBH). Two of the three Σ^+ vibrations for a linear HNBH structure are observed at 3700 cm^{-1}(ν_1) and 1785 cm^{-1}(ν_3) for the ^{11}B, ^{14}N species in an argon matrix. Calculations based on isotope effects predict a frequency of 2800 cm^{-1} for ν_2. One of the bending vibrations of HNBH is observed at 460 cm^{-1}. A second species appearing after prolonged photolysis of ammonia–borane is identified as HNB. Spectra of the photolysis products of borazine are associated with a species formed by ring opening, loss of hydrogen, and multiple BN bond formation. (auth)

24350 CHLORINE KINETIC ISOTOPE EFFECT MODELS. I. Isotopic Dependence in Nominal C–Cl Stretching Vibrations of Aliphatic Chlorides and Vibrational Analysis of the Tert-Butyl Chloride Ground State. Williams, R. C.; Taylor, J. W. (Univ. of Wisconsin, Madison). J. Amer. Chem. Soc.; 95: No. 6, 1710-1714(21 Mar 1973).

The infrared isotopic shift of the C–Cl stretching frequencies of methyl, ethyl, n-propyl, n-butyl, isopropyl, and tert-butyl chloride was determined, using isotopically labeled ^{35}Cl and ^{37}Cl compounds. Detailed high-resolution studies of tert-butyl chloride skeletal modes show at least three other important isotopic shifts, in addition to the nominal C–Cl mode. A point mass-methyl-group skeletal model of tert-butyl chloride used for vibrational analysis reproduces the experimental spectrum to within 0.051% and confirms isotopic splitting in more than one mode. The frequencies were also obtained as a function of solvent, and the isotopic shifts estimated from the methyl chloride shift, measured in methanol-d_1. Geometric factors influencing the size of the isotopic shift are discussed, and the implications for chlorine kinetic isotope effect calculations are enumerated. (auth)

24351 DEUTERIUM KINETIC ISOTOPE EFFECT IN ELIMINATION FROM PHENETHYL BROMIDES IN T-BUTYL ALCOHOL. Blackwell, L. F.; Buckley, P. D.; Jolley, K. W.; MacGibbon, A. K. H. (Massey Univ., Palmerston North, New Zealand). J. Chem. Soc., Perkin Trans., II; No. 2, 169-173(1973).

Deuterium kinetic isotope effects (k_2^H/k_2^D) were measured for the elimination of HBr from a series of substituted phenethyl bromides. No variation in the magnitude of the isotope effect was observed. The k_2^H values have been correlated by the Hammett equation to give $\rho = 2.85$. Some evidence for proton tunnelling was obtained. (auth)

24352 ISOTOPE EFFECT FOR THE DIFFUSION OF COBALT IN COPPER. Badrinarayanan, S.; Mathur, H. B. (National Chemical Lab., Poona, India). Indian J. Pure Appl. Phys.; 10: No. 7, 512-516(Jul 1972).

The isotope effect E for the diffusion of cobalt in copper was measured to have a value of 0.763 ± 0.048, independent of temperature in the interval 890 to 1033°C. This value of E when combined with $\Delta K = 0.87$ determined from the isotope effect for self-diffusion in Cu gave a value of the correlation factor $f = 0.87$, in good agreement with $f = 0.88$ calculated from the electrostatic model of LeClaire for the vacancy diffusion. (auth)

24353 REMARKABLE DEUTERIUM EFFECT ON THE RATE OF PHOTOSENSITIZED OXIDATION OF ALCOHOL DEHYDROGENASE AND TRYPSIN. Nilsson, R.; Kearns, D. R. (Univ. of Stockholm). Photochem. Photobiol.; 17: No. 1, 65-68(Jan 1973).

A brief note is presented of the use of the solvent deuterium effect on singlet oxygen lifetimes and azide quenching to demonstrate that the photodynamic inactivation of the enzymes alcohol dehydrogenase (ADH) and trypsin involves singlet oxygen. The study state irradiations were carried out in H_2O of D_2O using a 1000 W xenon lamp with a filter cutting off light below 350 nm. The inactivation of trypsin and ADH was ~10 times faster in D_2O than in H_2O. This is explained by the fact that in H_2O the lifetime of singlet oxygen is ~2 μsec, and in D_2O ~20 μsec. For both enzymes, addition of 10^{-2} M NaN_3 almost completely protected the enzymes against inactivation. This is also explained in terms of its known effect on the lifetime of singlet oxygen. (UK)

24354 IRON CARBONYL CATALYZED ISOMERIZATION OF 3-ETHYL-1-PENTENE. Multiple Olefin Isomerizations via a π-allyl Metal Hydride Intermediate. Casey, C. P.; Cyr, C. R. (Univ. of Wisconsin, Madison). J. Amer. Chem. Soc.; 95: No. 7, 2248-2253(4 Apr 1973).

The $Fe_3(CO)_{12}$ catalyzed isomerization of 3-ethyl-1-pentene-3-d_1 (1-d) gives 3-ethyl-2-pentene (2). The deuterium label in 2 was shown to be randomly scrambled among the three methyl groups of 2 by NMR and by ozonolysis of 2 which gave acetaldehyde and 3-pentanone with deuterium in the methyl groups only. NMR analysis of recovered 1-d indicated that scrambling of deuterium onto the methyl groups and the terminal vinyl carbon of 3-ethyl-1-pentene (1) occurs 1.8 ± 0.2 times more rapidly than isomerization of 1-d to 2. The absence of crossover products from the isomerization of a mixture of 1-d and 3-methyl-1-butene (3) demonstrated that the olefin isomerization reaction occurs via intramolecular hydrogen shifts. No primary deuterium isotope effect was observed when a mixture of 1 and 1-d was isomerized. The isomerization of a mixture of 1 and of 3-ethyl-2-pentene-1-d_3 (2-d_3) indicated that the isomerization of 1 to 2 is 3.6 ± 1.5 times faster than the degenerate isomerization of 2. An olefin isomerization mechanism involving a π-allyl metal hydride intermediate is invoked to explain the observed intramolecular 1,3 hydrogen shifts which accompany the isomerization of 1-d. The scrambling of deuterium in 2 and in recovered 1-d requires that the rate of isomerization of a complexed alkene be rapid in comparison with the rate of decomplexation of the alkene. (auth)

24355 AMINE CATALYSIS OF β-KETOL DEHYDRATION. II. Catalysis via Iminium Ion Formation. General Analysis of Nucleophilic Amine Catalysis. Hupe, D. J.; Kendall, M. C. R.; Spencer, T. A. (Dartmouth, Coll., Hanover, NH). J. Amer. Chem. Soc.; 95: No. 7, 2271-2278(4 Apr 1973).

A kinetic study of the dehydration of 9-hydroxy-10-methyl-cis-decalone-2 (1) to form 10-methyl-$\Delta^{1,9}$-octalone (2) in aqueous solution was made using a variety of primary and secondary amines as catalysts. Evidence, including a large primary kinetic isotope

effect with appropriately deuterated 1, was found for catalysis involving rate-limiting α-proton abstraction by general bases from an iminium derived from 1. When the general base is another molecule of the imine-forming amine, the bimolecular rate constant (k_{AB}) varies less than a factor of 2 over an amine basicity range of 10^5. This invariance results from a balancing of two effects: an increase in the effectiveness of the amine as a general base for α-proton abstraction with increasing pK_a ($\beta = 0.5$), and a decrease in the susceptibility of iminium ions to deprotonation with increasing pK_a. These findings lead to the conclusion that a nucleophilic amine catalyst for α deprotonation will be most effective when $pH = pK_a^N = pK_a^B$, where pK_a^N is the pK_a of the imine-forming amine and pK_a^B is the pK_a of the general base. The fact that this condition for maximum catalytic effectiveness can be met at neutral pH means that many enzymes have evolved which operate via iminium ion formation. The maximum rate of catalysis for an enzyme constrained to operate with $pH = pK_a^N = pK_a^B$ is estimated and compared with experimental values. (auth)

24356 ONE-PROTON SOLVATION BRIDGE IN INTRAMOLECULAR CARBOXYLATE CATALYSIS OF ESTER HYDROLYSIS. Minor, S. S.; Schowen, R. L. (Univ. of Kansas, Lawrence). J. Amer. Chem. Soc.; 95: No. 7, 2279-2281(4 Apr 1973).

The rate of hydrolysis of O-dichloroacetylsalicylic acid anion is independent of buffer strength and pH(D) in acetic acid–sodium acetate buffers in water, deuterium oxide, and their equimolar mixture at 25°. The rate constant k_n in solvents of mole fraction n deuterium oxide, mole fraction $1 - n$ of protium oxide, is given by $10^5 k_n = (7432 \pm 33)[1 - n + (0.460 \pm 0.008)n]$. The solvent isotope effect of $k_{H_2O}/k_{D_2O} = 2.17$ thus arises from a single transition-state proton (one-proton solvation bridge). (auth)

Isotope Exchange and Isotope Separation

Refer also to abstracts 24619 and 26668.

24357 (EUR-4938, pp 151-156) EXPERIMENTAL STUDY OF HYDROGEN IN LIQUID LITHIUM. Goodall, D. H. J.; McCracken, G. M. (Culham Lab., Abingdon, Eng.). Dec 1972.

From seventh symposium on fusion technology; Grenoble, France (24 Oct 1972).

Partial pressure of deuterium above Li–D solutions is measured at 700°C. The general relationship between dissociation pressure and concentration agrees quite well with the square root relation predicted by Sieverts Law in the concentration range 10^{-1} to 10^{-3} atomic fraction. The results at 700°C are approximated by the equation $C = 3 \times 10^{-2} P^{\frac{1}{2}}$ atomic fraction for P in torr. Below 10^{-3} atomic fraction there is a deviation from Sieverts Law with the experimental pressures being higher than predicted. The variation of dissociation pressure with temperature is given for three different concentrations. These results give a heat of solution of 21 ± kcals/mole. Possible sources of error in the measurements are considered. (EU)

24358 (EUR-4938, pp 157-167) TRITIUM SEPARATION AND RECOVERY SYSTEM USING A FLUIDIZED BED. Weichselgartner, H. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). Dec 1972.

From seventh symposium on fusion technology; Grenoble, France (24 Oct 1972).

The high diffusion coefficient for hydrogen through a niobium wall is one assumption of the proposed system; the other is the effectiveness of a heterogeneous gas/solid reaction in a fluidized bed assembly. This assembly surrounds the blanket of a fusion reactor. The tritium is chemically fixed onto the solid phase of the fluidized bed and then transferred into an external tritium recovery system. Some parameters of the fluidized bed assembly are given. The recovery process is neither spatially nor temporally coupled with the separation process. (auth)

24359 ENRICHING WITH HEAVY HYDROGEN ISOTOPES. Reilly, J. J. Jr.; Wiswall, R. H. Jr. (to United States Atomic Energy Commission). U. S. Patent 3,711,601. 16 Jan 1973. Filed date 12 Feb 1971. 4p.

A method of recovering deuterium and tritium from hydrogen is reported. Gaseous mixtures containing the heavy isotopes of hydrogen are exposed to vanadium hydride and the heavy isotopes undergo mass transference with the hydrogen of the vanadium hydride until the ratio of heavy hydrogen isotope atoms to hydrogen atoms in the vanadium hydride is greater than the ratio in the gas. (auth)

24360 INCREASED RECOVERY IN DUAL TEMPERATURE ISOTOPE EXCHANGE PROCESS. Babcock, D. F.; Neill, J. S. (to United States Atomic Energy Commission). U. S. Patent 3,711,598. 16 Jan 1973. Filed date 11 May 1971. 12p.

A liquid with a gas each containing a desired isotope flows counter-currently through two liquid-gas contacting towers. The towers are maintained at different temperatures to enrich the liquid in the isotope within the cold tower and the gas in the isotope within the hot tower. The liquid, having the natural concentration of the desired isotope, is fed into the top of the cold tower, and the gas flowing upwardly through the towers is recirculated from the top of the cold tower into the bottom of the hot tower. The liquid feed is then increased and a portion of the liquid is withdrawn from an intermediate location in the upper portion of the cold tower and fed into the lower portion of the hot tower to increase the productivity of the process. This process is particularly applicable to the recovery of deuterium oxide from water. (Official Gazette)

24361 HYDROGEN EXCHANGE STUDIES. VIII. Base-catalyzed Hydrogen Exchange of 1,3,5-Trinitrobenzene in Aqueous Dimethylformamide. Buncel, E.; Symons, E. A. (Queen's Univ., Kingston, Ont.). J. Org. Chem.; 38: No. 6, 1201-1204(23 Mar 1973).

The rate of aromatic proton exchange between 1,3,5-trinitrobenzene (TNB) and dimethylformamide–D_2O containing sodium deuterioxide was measured as a function of medium composition and reactant concentration. In contrast to the normally observed trend of base-induced exchange rates in protic–aprotic solvent mixtures, in this system the pseudo-first-order rate constants for exchange decrease with increasing DMF content over the range 25 to 80 mole % DMF, when the TNB is present in excess over the base. Also, for constant medium composition and base concentration, the rates are halved on doubling the TNB concentration. This unusual behavior is interpreted as arising from competition between proton exchange and Meisenheimer complex formation. (auth)

24362 FACILE EXCHANGE OF AROMATIC HYDROGEN WITH DEUTERIUM IN THE ABSENCE OF CATALYSTS. Meta Aromatic Diamines. Grivas, J. C. (Sherwin-Williams Co., Chicago). J. Org. Chem.; 38: No. 6, 1204-1206(23 Mar 1973).

m-Phenylenediamines exchange ring hydrogen with deuterium at room temperature in the absence of catalysts. At concentrations of 1 mmole of amine per 1 ml of methanol-d_4 equilibrium at 60 to 80% deuteration is established within 24 to 60 hr. Under the same conditions o- and p-phenylenediamines completely fail to react. Only hydrogens at ortho and/or para positions to both amine groups exchange. A third mechanism, involving the direct attack of a deuterium cation on the electron-rich carbon atom in the rate-determining step, is postulated. (auth)

24363 DEUTERIUM–HYDROGEN MONOTHERMAL EXCHANGE. Rae, H. K. (to Atomic Energy of Canada Ltd.). U. S. Patent 3,716,621. 13 Feb 1973. Priority date 8 Apr 1969, Canada. 4p.

A monothermal exchange process of extracting deuterium from ammonia synthesis gas is proposed. The gas is passed through an exchange liquid stream consisting of a liquid amine having up to five carbon atoms per molecule causing deuterium to be transferred from the synthesis gas to the exchange liquid and removing a stream of exchange liquid enriched in deuterium from it. (Official Gazette)

24364 ISOTOPIC ENRICHMENT OF CARBON-13 AND OXYGEN-18 IN THE ULTRAVIOLET PHOTOLYSIS OF CARBON MONOXIDE. Dunn, O.; Harteck, P.; Dondes, S. (Rensselaer Polytechnic Inst., Troy, NY). J. Phys. Chem.; 77: No. 7, 878-883(29 Mar 1973).

Using the 2062.4-Å iodine line, the isotopic enrichment of ^{13}C and ^{18}O was studied in the photolysis of CO. Using CO containing $^{13}C^{16}O$, $^{12}C^{18}O$, and $^{13}C^{18}O$, the isotope effect was examined in the products of the photolysis, i.e., CO_2 and C_3O_2. Isotope separation factors for ^{13}C enrichment in C_3O_2 of 4 and in CO_2 of 2.5 and ^{18}O enrichment in CO_2 of 5 for a single-step process were obtained. Also included are extinction coefficient determinations at 2062.4 Å. The mechanism of the photolytic reaction is examined from the enrichment, which serves as a tracer, and from energy transfer considerations. (auth)

Feed Materials Processing

24365 (AAEC/LIB/Bib-361) SOLVENT EXTRACTION OF URANIUM ORES. A BIBLIOGRAPHY. Newland, E. A. (comp.) (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Jul 1972. 112p. Dep. NTIS (U. S. Sales Only) $7.75.

Fifty-nine general references on solvent extraction and 484 specific references on extraction of uranium ores are listed covering the period 1945 through 1972. Arrangement is chronological by year and alphabetical by author within each year. Reference is made to an abstract for each item. (Australia)

24366 REDUCTIVE STRIPPING PROCESS FOR THE RECOVERY OF URANIUM FROM WET-PROCESS PHOSPHORIC ACID. Hurst, F. J.; Crouse, D. J. (to United States Atomic Energy Commission). U. S. Patent 3,711,591. 16 Jan 1973. Filed date 8 Jul 1970. 4p.

A reductive stripping flow sheet for recovery of uranium from wet-process phosphoric acid is described. Uranium is stripped from a uranium-loaded organic phase by a redox reaction, converting the uranyl to uranous ion. The uranous ion is reoxidized to the uranyl oxidation state to form an aqueous feed solution highly concentrated in uranium. Processing of this feed through a second solvent extraction cycle requires far less stripping reagent as compared to a flow sheet that does not include the reductive stripping reaction. (Official Gazette)

Radiation Chemistry

Refer also to abstract 24832.

24367 (BNWL-SA-4314) FLUORESCENCE EXCITATION AND QUENCHING IN ORGANIC LIQUIDS UNDER ULTRAVIOLET AND IONIZING RADIATION. West, M. L. (Battelle Pacific Northwest Labs., Richland, Wash.). May 1972. Contract AT-(45-1)-1830. 15p. (CONF-720530-8). Dep. NTIS $3.00.

From 20th annual meeting of the Radiation Research Society; Portland, Oregon, USA (14 May 1972).

Single photon counting techniques were used to study the fluorescence response and time dependence of dilute solutions of benzene in cyclohexane excited by proton and ultraviolet (uv) radiation. Luminescence emitted after proton excitation decays nonexponentially whereas the same solutions under uv excitation show exponential decay. An attempt was made to show that these results are consistent with a diffusional quenching model whereby excited benzene molecules created along a localized proton track are quenched as they diffuse from initial reaction sites. (auth)

24368 (JEN-238) RESEARCH INTO AROMA CHANGES IN IRRADIATED FOODSTUFFS. I. Studies on Fish. Barrera Pinero, R.; Gasco Sanchez, L.; Valverde Garcia, F. (Junta de Energia Nuclear, Madrid (Spain)). 1972. 142p. (In Spanish). Dep. NTIS (U. S. Sales Only) $9.25.

Radiolytic formation of volatile compounds were investigated in fillets of hake, codfish, and bonito gamma-irradiated at a dose range of 0.1 to 5 Mrads. Analytical methods were developed by gas chromatography of functional group derivatives: carbonyls as 2,4-dinitrophenyl hydrazones, primary and secondary amines as N-alkyl benzamides, and thiols as 2,4-dinitrophenyl alkyl thioethers. The main results are as follows: increasing with the integral dose of the whole carbonyls, the most significant components being acetaldehyde, propionaldehyde and formaldehyde; no significant variations with the integral dose of the traces of ammonia, methylamine, trimethylamine, ethylamine, diethylamine, propylamine, butylamine, and pentylamine found in unirradiated samples; and radiolytic formation of methanethiol and dimethyl disulfide. Furthermore, radiolysis tests on fish constituents were initiated with trimethylamine oxide. N,N,N',N'-Tetramethylmethylenediamine, formaldehyde, water, dimethylformamide, and trimethylamine were identified as main radiolytic compounds from anhydrous TMAO samples gamma-irradiated at a dose range of 50 to 200 Mrads. (auth)

24369 INTERACTION OF 5-keV ELECTRONS WITH ISOCYANATE HOMOPOLYMERS. Levine, A. W.; Kaplan, M.; Fech, J. Jr. (RCA Corp., Princeton, NJ). J. Polymer Sci., Polym. Chem. Ed.; 11: No. 1, 311-313(Jan 1973).

N-Substituted-1-nylons corresponding to butyl, hexyl, octyl, dodecyl, and 4-methoxyphenyl isocyanate were prepared, treated with appropriate solvents, and exposed to an electron beam of 5 keV. Photomicrographs of rasters produced in the hexyl and 4-methoxyphenyl nylons are given. (JGB)

24370 RADIATION CHEMISTRY. An Introduction. Swallow, A. J. New York; John Wiley and Sons, Inc. (1973). 285p.

The broad field of radiation chemistry is discussed under the following chapter titles: sources of radiation; absorption of radiation in matter; radiation dose and its measurement; short-lived intermediates; inorganic solids; gases; water and aqueous solutions; organic compounds; polymeric systems, substances of biological interest; and, an appendix of units and conversion factors. (JGB)

24371 GRAFT COPOLYMERIZATION OF STYRENE AND LIGNIN. III. Chain Transfer Reactions of Lignin and Lignin Model Compounds. Phillips, R. B.; Brown, W.; Stannett, V. (North Carolina State Univ., Raleigh). J. Appl. Polym. Sci.; 17: No. 2, 443-451(Feb 1973).

The effect of addition of lignin model compounds on the polymerization rate and molecular weight of polymer in the radio-induced polymerization of styrene was studied. Guaiacol, a model for softwood lignin, reacted slowly with styrene radicals, while 2,6-dimethoxyphenol, a hardwood lignin model, was a much more efficient chain transfer agent. Studies with isoeugenol indicate that allylic or phenoxy radical stability in a conjugated system may terminate polymerization quite effectively. The results are discussed in the light of new and previous data with isolated lignins; they are consistent with the previously presented grafting scheme. (auth)

24372 SPHEROIDIZATION OF SILVER ETHYLENE OXIDATION CATALYST PARTICLES AS INDUCED BY γ-IRRADIATION. Kuczynski, G. C.; Carberry, J. J.; Martinez, E. (Univ. of Notre Dame, IN). J. Catal.; 28: No. 1, 39-45(Jan 1973). (COO-38-842).

Following γ-irradiation and then exposure of a supported silver catalyst to ethylene and O_2 at 280°C, scanning electron microscopy (SEM) reveals spheroidization of the silver particles, a phenomenon not observed in the absence of preirradiation. Electron spectroscopy chemical analyses (ESCA) studies and etching of the samples suggest the presence of a distinct, included phase of Ca oxide within the Ag. Irradiation apparently causes multiple ionization with ejection of ionized Ca to the Ag particle surface, spheroidization being one consequence. (auth)

24373 RADIOLYSIS OF $CF_4-C_2F_6$ MIXTURES. Askew, W. C.; Reed, T. M. III. (Univ. of Florida, Gainesville). Ind. Eng. Chem., Prod. Res. Develop.; 11: No. 4, 447-449(1972).

Mixtures of CF_4 with C_2F_6 were exposed to cobalt-60 gamma rays. Mixtures were also irradiated by neutrons and gamma rays in the Low Intensity Training Reactor at Oak Ridge. These materials were converted to mixtures of higher molecular-weight perfluoroalkanes containing no unsaturated molecules. The predominant structures in the products were C_3F_8 and branched-chain perfluoroalkanes, i-C_4F_{10}, i-C_5F_{12}, 2,3-$(CF_3)_2C_4F_8$. Chain-transfer processes and termination by radical combination were the predominant processes in perfluorocarbon radiolysis. (auth)

24374 IRRADIATION TREATMENT OF PCB [POLYCHLORINATED BIPHENYLS] IN WATER. Sunada, T. (Radiation Center of Osaka Prefecture, Sakai, Japan). At. Jap.; 16: No. 6, 7-9 (Jun 1972).

Recently environmental pollution with PCB (polychlorinated biphenyls) has become a serious and world-wide problem because of their high resistance to heat, chemicals, and biolysis, and their toxicity to liver and skin of men. Although some treatment of the PCB in water such as chemical coagulation, adsorption by activated carbon, or distillation can achieve a greater degree of removal, intact PCB would contaminate environment again because these can not destroy the PCB. Irradiation seems to have a prospective role in the treatment of the PCB, because irradiation products show less toxicity. Dibenzofuran, an oxidized product of the PCB and more toxic, cannot be detected from the extract of irradiated solution of the PCB by means of thin-layer chromatography. Also, striped shrimps, 30 to 40 mm in length, all survived for 24 hours in the solution irradiated with 10 Mrad, whereas 40% of those immersed died in the same period in non-irradiated solution. (Japan)

24375 CHANGES IN THE SORPTION CAPACITY OF ANION EXCHANGERS FOR GOSSYPOL AND FOR FREE FATTY ACIDS UNDER THE INFLUENCE OF GAMMA RADIATION. Turusunov, M.; Rizaev, N. U.; Mirzakarimov, R. M.; Ibragimov, A. P.; Sukhinina, L. A. (Tashkent Polytechnic Inst.). J. Appl. Chem. USSR (Engl. Transl.); 45: No. 8, 1904-1908(Aug 1972).

Translated from Zh. Prikl. Khim.; 45: No. 8, 1828-1832(Aug 1972).

Resins were treated with γ doses of 500 to 20×10^6R. Increase of the γ dose increases the swelling of the anion exchangers AV-17-6(m) and ÉDÉ-10p in OH^- form in distilled water and in methyl alcohol, while the swelling of ÉDÉ-10p resin in the CO_3^{2-} form and of FAN-2 in OH^- form increases with the dose up to a certain limit. The resins also increase in weight. After γ irradiation, AV-17-6(m) resin in the OH^- form exhibits selective sorption with respect to gossypol. The anion exchangers AV-17-6(m) and ÉDÉ-10p in the CO_3^{2-} form become paler in color with increase of the radiation dose. (JGB)

24376 EFFECT OF γ RAYS IRRADIATION ON COTTON FIBRE AND YARN. Sandila, D. M.; Shamim, M. (Pakistan Inst. of Cotton Research and Tech., Karachi). Pak. J. Sci. Ind. Res.; 15: No. 1-2, 127-130(1972).

Effects of γ radiation on raw cotton and cotton yarn were studied. Results indicate that the strength of the fibre or yarn decreases when exposed to γ rays. The rate of decrease increases with the increase in the dose of γ radiation. The color of cotton fibres and

yarn changes to light brown while the crystallite orientation angle of cotton fibres increases with the increase in irradiation dose. All the above changes in characteristics are attributed to chemical modification in the structure of cellulose. (auth)

24377 RADIATION DECOMPOSITION OF WATER AT HIGH TEMPERATURES AND PRESSURES. Burns, W. G.; Marsh, W. R.; Barton, R. A. (Atomic Energy Research Establishment, Harwell, Eng.). Nature (London) Phys. Sci.; 241: No. 108, 85-86(22 Jan 1973).

Reference is made to Michael, Hart and Schmidt (J. Phys. Chem. 75: 2798 (1971)) who published data on the absorption spectrum of $e^-_{D_2O}$ in the temperature range −4° to 390°C as a function of time. In the kinetic analysis of data in the range 300° to 390°C it was not possible to distinguish between three mechanisms that could lead to the observed absorbances; these values were lower than obtained by calculations involving the use of standard yields and the extrapolation of rate constants for lower temperatures. The mechanisms involved (a) increase of rate constants by factors from 2.5 to 5, (b) increase of G(D) from 0.4 to 10 and G(OD) from 2.9 to 12.5, and (c) lowering of $G(e^-_{D_2O})$ from 3.1 to 1.1. Evidence has now been obtained that (c) plays at least some part. Purified water containing scavengers for OH, H and e^-aq. was irradiated with 9 MeV protons at ~400°C in a flow system and product concentrations were measured for known values of the rate of input of radiation energy and rate of water flow under steady conditions. The rate of energy input to the irradiated water was checked by determining the N_2 yield from saturated solutions of N_2O. (UK)

24378 γ-IRRADIATION OF AQUEOUS SOLUTIONS OF MONOSACCHARIDES AT 77°K. Nikitin, I. V.; Miroshnichenko, I. V.; Kudryashov, L. I.; Dyatkina, M. E.; Kochetkov, N. K. (Inst. of Organic Chemistry, Moscow). Dokl. Akad. Nauk SSSR; 207: No. 5, 1125-1128(11 Dec 1972). (In Russian).

The effects of ^{60}Co γ radiation on frozen aqueous solutions of three pentoses, arabinose, xylose, and ribose, and three hexoses, galactose, glucose, and mannose were investigated by means of EPR spectra. The irradiation was conducted at 77°K, and the spectra were taken over the range 77 to 190°K. All spectra were practically identical and are discussed in the light of previous studies. (KSW)

24379 RADIATION CHEMISTRY. An Introduction. Swallow, A. J. London; Longman (1973). 275p.

The subject is dealt with in chapters, of which the first three cover, respectively, sources of radiation, absorption of radiation in matter, and radiation dose and its measurement. The remaining chapters cover short-lived intermediates (production of intermediates in the primary activation, excited species, ions, free radicals, direct study of intermediates); inorganic solids (stored energy, electrical conductivity, thermal conductivity, dimensional changes, order-disorder changes in alloys, phase changes, mechanical properties, color changes, chemical decomposition, surface reactions); gases (hydrogen, oxygen, water vapor, nitrogen and compounds of nitrogen, oxides of carbon, methane, ethylene, and other gases); water and aqueous solutions (intermediates in the radiolysis of water, dilute ferrous sulphate solutions, other dilute solutions, concentrated solutions); organic compounds (saturated hydrocarbons, unsaturated hydrocarbons, aromatic hydrocarbons, alcohols, other organic compounds); polymeric systems; substances of biological interest (carbohydrates, polysaccharides, amino acids and peptides, thiols and disulphides, proteins, electron transport systems, nucleic acids and their components, lipids, effects in organized biological systems). Several problems are included at the end of each chapter, and a list of references. (UK)

24380 CHEMICAL EFFECTS OF γ-IRRADIATION OF AQUEOUS SOLUTIONS OF CHONDROITIN-4-SULPHATE. Moore, J. S.; Phillips, G. O.; Rhys, D. (Salford Univ., Eng.). Int. J. Radiat. Biol.; 23: No. 2, 113-119(Feb 1973).

After γ radiolysis of deaerated aqueous solutions of sodium chondroitin 4-sulfate, acids (G = 2.6) and reducing products (G = 0.4) are readily produced. The yields of these products are approximately doubled when the irradiation is carried out in N_2O-saturated solution. Depolymerization of the polymer is accompanied by a decrease in the ability of the polymer to bind to methylene blue and cetyl pyridinium chloride, and at a dose of 11×10^{18} eV ml^{-1} in argon-saturated solution, five low molecular weight products, the smallest of which approximates to a tetramer, are readily discernable. Analysis of the products indicates that the hexosamine moiety is more stable towards ionizing radiations than the hexuronic acid. (auth)

24381 TRIPHENYLAMINE AND NAPHTHALENE SENSITIZED PHOTOLYSIS OF SOME ALKYLACETATES AT 77°K. Bettger, T.; Fuki, V. K.; Fok, N. V. (Moscow State Univ.). Dokl. Akad. Nauk SSSR; 207: No. 3, 632-635(21 Nov 1972). (In Russian).

Photolysis experiments were conducted at 77°K with triphenylamine (TPA) as the sensitizer and the esters ethyl, n-propyl, and isopropyl acetate as the matrix molecules. In some experiments the light used was the interval $270 \leq \lambda \leq 380$ mμ; the results were compared with those from λ irradiation. EPR spectra of the irradiated mixtures formed the basis for a discussion as to possible anion radical mechanisms involved. (KSW)

24382 PULSE RADIOLYTIC OXIDATION OF CHLORAL HYDRATE IN OXYGENATED AND DEOXYGENATED AQUEOUS SOLUTIONS. Eriksen, T.; Henglein, A.; Stockhausen, K. (Hahn Meitner-Institut fuer Kernforschung, Berlin). J. Chem. Soc., Faraday Trans., I; 69: No. 2, 337-345(1973).

Dilute chloral hydrate solutions containing either N_2O or a $N_2O + O_2$ mixture were pulse irradiated and their optical absorption and electrical conductivity simultaneously recorded as functions of time. The first product of OH and H attack on chloral hydrate is the $CCl_3C(OH)_2$ radical. The pK of its electrolytic dissociation was found to be 6.9 ± 0.2. In the absence of O_2, it disappears by disproportionation to yield trichloroacetic acid. The rate constant 2k is equal to $(7.0 \pm 1) \times 10^8 M^{-1}s^{-1}$ at pH = 5.5 and $(4.4 \pm 0.7) \times 10^8 M^{-1}s^{-1}$ at pH = 10.8. $CCl_3\dot{C}(OH)_2$ adds O_2 with $k = (1.0 \pm 0.2) \times 10^9 M^{-1}s^{-1}$. The resulting peroxy radical $CCl_3\dot{O}_2(OH)_2$ is a bivalent acid with the pK- values of 3.3 ± 0.3, and 8.7 ± 0.3, respectively. Two peroxyradicals react with $2k = (1.7 \pm 0.3) \times 10^8 M^{-1}s^{-1}$ to produce a product that finally disappears by first order kinetics. The product is assigned the structure of a hydrotetroxide, $CCl_3C(OH)_2O_4H$, which is strongly dissociated into $CCl_3C(OH)_2^{\cdot} + HO_2^{\cdot}$. Its decay is explained by the loss of oxygen. (auth)

24383 EFFECT OF RADICAL SCAVENGERS AND ELECTRIC FIELDS ON THE γ-RADIOLYSIS OF GASEOUS HYDROGEN SULPHIDE. Huyton, D. W.; Woodward, T. W. (Univ. of Salford, Eng.). J. Chem. Soc., Faraday Trans., I; 69: No. 2, 467-473 (1973).

In the γ-radiolysis of H_2S with added 1,3-butadiene, H atoms appear to react before they become thermalized. With added benzene, propene, and 1-butene insufficient scavenging occurs to say with certainty whether a similar situation applies, but indications are that it may be so for propene, and 1-butene. Investigation of the effect of 1-butene on the sulphur yield, indicates a dose rate effect which is explained by a competition between ion-recombination and diffusion to the wall enhanced by convection currents. Yields of $G(H_2) = G(S) = 0.5$ unscavengable by 1,3-butadiene are indicated and evidence is given that excited sulphur atoms (S^*) and S^+ ions are probable precursors of these yields. Nitric oxide appears to react with SH radicals in a chain process producing H_2O, N_2O, and S. Electric fields do not affect the radiation yields until electron acceleration just before saturation occurs, causes increased decomposition. The ratio of sulphur scavengable in the presence of a field is ~4:1, which is much lower than in the absence of a field (13:1). This is evidence for production of excited S atoms by field accelerated electrons. (auth)

24384 REACTIONS OF THE HYDROXY PEROXY RADICALS $HOCH_2O_2$ AND CH_3CHOHO_2 IN AQUEOUS SOLUTION. Downes, M. T.; Sutton, H. C. (Inst. of Nuclear Science, Lower Hutt, New Zealand). J. Chem. Soc., Faraday Trans., I; 69: No. 2, 263-279 (1973).

The products formed from $HOCH_2O_2(RO_2)$ radicals during (a) radiolysis of oxygen saturated aqueous solutions of methanol by γ-rays and 1.8 MeV electrons, and (b) photolysis of similar solutions containing H_2O_2 are HCOOH, HCHO, CH_2OHO_2H, and H_2O_2. Some of the HCHO is formed initially in the keto form and is subsequently hydrated to $CH_2(OH)_2$. The major organic product at pH 2 is HCOOH. At low radiation intensities G(HCOOH)/G(HCHO) and ϕ(HCOOH)/ϕ(HCHO) decrease to zero with increasing pH in the range 3 to 6.5; at high dose rates this range extends from pH 3 to pH 8.5. These observations and those of an earlier pulse radiolysis study by Stockhausen et al. (Ber. Bunsenges.; 74: 34 (1970)) are interpreted quantitatively in terms of reactions of the species $HOCH_2O_4CH_2OH$(A), $HOCH_2O_4CH_2O^-$(B^-), and $OCH_2O_4CH_2O^=$($C^=$) formed by bimolecular reactions of RO_2. At low dose rates HCOOH is formed by unimolecular decomposition of A; at high dose rates it is formed also by bimolecular reactions of B^- with B^- and its yield is controlled by both the equilibria $A \rightleftharpoons B^- + H^+$ (pK ~ 4.6) and $B^- \rightleftharpoons C^= + H^+$ (pK ~ 7.1) or $HOCH_2O_2 \rightleftharpoons O_2CH_2O^- + H^+$ (pK ~ 6.8). HCHO results partially from unimolecular decomposition of RO_2 into HCHO + HO_2 with $k \simeq 9.9s^{-1}$, and also from reactions of $C^=$, B^- and A. Reactions of $HOC_2H_4O_2$ are similar. An unusual reaction occurs at high dose rates in the pH region where B^- and $C^=$ co-exist and causes the product yield to exceed $G(RO_2)$; its nature and mechanism are discussed. (auth)

24385 THERMAL FORMATION OF OXYGEN RADICALS ON Y-TYPE ZEOLITES. Imai, T.; Habgood, H. W. (Research

Council of Alberta, Edmonton). J. Phys. Chem.; 77: No. 7, 925-931(29 Mar 1973).

ESR spectra showed that two different oxygen radicals were thermally formed on the sodium and the lithium forms of Y-type zeolite, but not on the potassium form. The radicals were formed only on the zeolites with high ratios of the alkali metal ions to aluminum ions. The spin concentration of the radicals was in the order of 10^{15} spin/g. The first radical is superoxide ion O_2^- adsorbed on the alkali metal ions and similar to that already known to be formed by γ irradiation. The second radical was favored at higher temperatures and distinctly increased upon adding copper or iron ions together with NaOH or LiOH to the samples. This latter radical reacted with hydrogen sulfide at room temperature and a sulfur radical was produced as a product. (auth)

24386 SCAVENGING OF e^-_{aq} AND ON THE POSSIBLE BREAKDOWN OF SMOLUCHOWSKI'S EQUATION AT HIGH CONCENTRATIONS OF SOLUTES. Czapski, G.; Peled, E. (Hebrew Univ., Jerusalem). J. Phys. Chem.; 77: No. 7, 893-897(29 Mar 1973).

It is shown that in very concentrated aqueous solutions of electron scavengers, the initial decay of e^-_{aq} with scavengers by diffusion-controlled reactions may break down due to different reasons. In addition to the known time dependence of these rate constants, it is argued that other effects have to be taken into consideration: (a) the finite lifetime of encounter pairs; (b) the initial formation (not through diffusion) of encounter pairs in concentrated solutions; and (c) possible effects prior to thermal equilibration. These effects may explain some of the anomalies in kinetic behavior and in $G(e^-_{aq})$ in the radiation chemistry of such concentrated solutions without necessarily having to postulate any chemical reactivity with dry electrons. (auth)

24387 PROCEEDINGS OF THE THIRD TIHANY SYMPOSIUM ON RADIATION CHEMISTRY. VOLUME I. Conference held in Tihany, Hungary, May 10-15, 1971. Dobo, J.; Hedvig, P. (eds.). Budapest; Akademiai Kiado (1972). 1089p. (CONF-710517-Vol.1)). $42.00.

From 3rd symposium on radiation chemistry; Tihany, Hungary (10 May 1971).

Separate entries are given for the 93 papers presented. For abstracts of three papers that appeared previously in NSA see CONF-710517 in the report number index. (DHM)

For abstracts of individual papers see: 24388 through 24481.

24388 PULSE RADIOLYSIS OF ALKYL KETONES. Bach, N. A.; Ermakova-Borisenko, G. L.; Revina, A. A. (Inst. of Electrochemistry, Moscow). pp 37-46 of Proceedings of the third Tihany symposium on radiation chemistry. Vol. I. Dobo, J. (ed.). Budapest; Akademiai Kiado (1972).

See CONF-710517-(Vol.1).

24389 RADIOTHERMOLUMINESCENCE OF ALIPHATIC KETONES. Kroh, J.; Wypych, M. (Technical Univ., Lodz, Poland). pp 47-58 of Proceedings of the third Tihany symposium on radiation chemistry. Vol. I. Dobo, J. (ed.). Budapest; Akademiai Kiado (1972).

From 3rd symposium on radiation chemistry; Tihany, Hungary (10 May 1971). See CONF-710517-(Vol.1).

24390 ENERGY TRANSFER IN 1,4-DIOXANE AS STUDIED BY RADIOLUMINESCENCE. Spurny, F. (Faculty of Nuclear Sciences and Physical Engineering, Prague). pp 59-69 of Proceedings of the third Tihany symposium on radiation chemistry. Vol. I. Dobo, J. (ed.). Budapest; Akademiai Kiado (1972).

From 3rd symposium on radiation chemistry; Tihany, Hungary (10 May 1971). See CONF-710517-(Vol.1).

24391 TEMPERATURE DEPENDENCE OF 1- AND 2-PROPANOL γ RADIOLYSIS. Afanas'ev, A. M.; Kalyazin, E. P. (Moscow State Univ.). pp 71-80 of Proceedings of the third Tihany symposium on radiation chemistry. Vol. I. Dobo, J. (ed.). Budapest; Akademiai Kiado (1972).

From 3rd symposium on radiation chemistry; Tihany, Hungary (10 May 1971). See CONF-710517-(Vol.1).

24392 RADIOLYSIS OF ETHYLAMINE, DIETHYLAMINE, AND TRIETHYLAMINE. Habersbergerova, A.; Janovsky, I.; Teply, J. (Nuclear Research Inst., Rez, Czech.). pp 81-85 of Proceedings of the third Tihany symposium on radiation chemistry. Vol. I. Dobo, J. (ed.). Budapest; Akademiai Kiado (1972).

From 3rd symposium on radiation chemistry; Tihany, Hungary (10 May 1971). See CONF-710517-(Vol.1).

24393 RADIOLYSIS OF LITHIUM OXALATE INDUCED BY THE REACTION $^6Li(n,\alpha)^3H$. Gal, O.; Baugh, P. J.; Phillips, G. O. (Univ. of Salford, Eng.). pp 87-95 of Proceedings of the third Tihany symposium on radiation chemistry. Vol. I. Dobo, J. (ed.). Budapest; Akademiai Kiado (1972).

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24394 RADIATION-THERMAL ISOMERIZATION OF n-ALKYL BROMIDES. Pozdeev, V. V. (Inst. of Physical Chemistry, Moscow). pp 97-103 of Proceedings of the third Tihany symposium on radiation chemistry. Vol. I. Dobo, J. (ed.). Budapest; Akademiai Kiado (1972).

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24395 RADIATION CHEMISTRY OF TRIBUTYL PHOSPHATE SOLUTIONS. Barelko, E. V.; Solyanina, I. P. (Inst. of Physical Chemistry, Moscow). pp 105-114 of Proceedings of the third Tihany symposium on radiation chemistry. Vol. I. Dobo, J. (ed.). Budapest; Akademiai Kiado (1972).

From 3rd symposium on radiation chemistry; Tihany, Hungary (10 May 1971). See Conf-710517-(Vol.1).

24396 RADIOLYSIS OF ADAMANTANE. Podhalyuzin, A. T.; Vereshchinskii, I. V. (Inst. of Physical Chemistry, Moscow). pp 115-121 of Proceedings of the third Tihany symposium on radiation chemistry. Vol. I. Dobo, J. (ed.). Budapest; Akademiai Kiado (1972).

From 3rd symposium on radiation chemistry; Tihany, Hungary (10 May 1971). See CONF-710517-(Vol.1).

24397 RECENT STUDIES ON ELECTRON ATTACHMENT. Christophorou, L. G. (Oak Ridge National Lab., TN). pp 123-146 of Proceedings of the third Tihany symposium on radiation chemistry. Vol. I. Dobo, J. (ed.). Budapest; Akademiai Kiado (1972).

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24398 DETERMINATION OF THE ABSOLUTE VALUES OF RATE CONSTANTS OF RADIATION-CHEMICAL REACTIONS IN EXPERIMENTS WITH A PERIODIC SOURCE. Brodskii, A. M.; Chernenko, A. A. (Moscow State Univ.). pp 147-156 of Proceedings of the third Tihany symposium on radiation chemistry. Vol. I. Dobo, J. (ed.). Budapest; Akademiai Kiado (1972).

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24399 INVESTIGATION OF THE CHARGED PARTICLES IN THE PULSE RADIOLYSIS OF ORGANIC LIQUIDS. Vannikov, A. V.; Mal'tsev, E. I.; Rudnev, A. V. (Inst. of Electrochemistry, Moscow). pp 157-167 of Proceedings of the third Tihany symposium on radiation chemistry. Vol. I. Dobo, J. (ed.). Budapest; Akademiai Kiado (1972).

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24400 IONIC REACTIONS DURING RADIOLYSIS OF ORGANIC LIQUIDS. Kroh, J.; Karolczak, S.; Piekarska, J. (Technical Univ. of Lodz, Poland). pp 169-181 of Proceedings of the third Tihany symposium on radiation chemistry. Vol. I. Dobo, J. (ed.). Budapest; Akademiai Kiado (1972).

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24401 PHOTOIONIZATION OF AROMATICS IN SOLID SOLUTIONS. Bernas, A.; Gauthier, M.; Grand, D. (Univ., Paris). pp 183-193 of Proceedings of the third Tihany symposium on radiation chemistry. Vol. I. Dobo, J. (ed.). Budapest; Akademiai Kiado (1972).

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24402 IONIC PROCESSES IN γ-IRRADIATED 3-METHYLHEXANE. Balog, J.; Toth, L.; Pinter, K. (Central Research Inst. of Physics, Budapest). pp 195-203 of Proceedings of the third Tihany symposium on radiation chemistry. Vol. I. Dobo, J. (ed.). Budapest; Akademiai Kiado (1972).

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24403 ELECTRICAL CONDUCTIVITY OF IRRADIATED INSULATING ORGANIC LIQUIDS AND GLASSES. Kosa-Somogyi, I.; Toth, L.; Balog, J. (Central Research Inst. for Physics, Budapest). pp 205-217 of Proceedings of the third Tihany symposium on radiation chemistry. Vol. I. Dobo, J. (ed.). Budapest; Akademiai Kiado (1972).

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24404 COMPETITION FOR ELECTRONS IN THE SYSTEM 2,2,4-TRIMETHYLPENTANE-10% ETHANOL-CHLOROBENZENE. Dvornik, I.; Zec, U. (Inst. Rudjer Boskovic, Zagreb). pp 219-222 of Proceedings of the third Tihany symposium on radiation chemistry. Vol. I. Dobo, J. (ed.). Budapest; Akademiai Kiado (1972).

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24405 SCAVENGING OF ELECTRONS PRIOR TO THERMALIZATION IN ETHANOL. Razem, D.; Dvornik, I. (Inst. Rudjer Boskovic, Zagreb). pp 223-228 of Proceedings of the third Tihany symposium on radiation chemistry. Vol. I. Dobo, J. (ed.). Budapest; Akademiai Kiado (1972).

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24406 KINETICS OF THE RADIOLYSIS OF NITROGEN-METHANE MIXTURES. Zhdamirov, G. G.; Kornienko, V. N.; Borisov, E. A.; Rumayntsev, Yu. M.; Dzantiev, B. G. (Inst of Physical Chemistry, Moscow). pp 229-238 of Proceedings of the third Tihany symposium on radiation chemistry. Vol. I. Dobo, J. (ed.). Budapest; Akademiai Kiado (1972).

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24407 EFFECT OF THE CYCLIC STRUCTURE OF GASEOUS HYDROCARBONS ON THE PRODUCTS OF RADIOLYSIS. Horvath, Zs. (Inst. of Isotopes, Budapest); Foeldiak, G.; Gruber, L. pp 239-245 of Proceedings of the third Tihany symposium on radiation chemistry. Vol. I. Dobo, J. (ed.). Budapest; Akademiai Kiado (1972).

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24408 RADIATION CHEMICAL METHYLATION OF ETHYLENE. Stenger, V.; Jakab, A.; Foeldiak, G. (Inst. of Isotopes, Budapest). pp 247-255 of Proceedings of the third Tihany symposium on radiation chemistry. Vol. I. Dobo, J. (ed.). Budapest; Akademiai Kiado (1972).

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24409 INVESTIGATION OF ION-MOLECULE-REACTIONS AT ELEVATED PRESSURES BY ABSORPTION SPECTROSCOPY. Dryer, J. W.; Perner, D.; Roeth, E. P. (Kernforschungsanlage, Juelich, Ger.). pp 257-270 of Proceedings of the third Tihany symposium on radiation chemistry. Vol. I. Dobo, J. (ed.). Budapest; Akademiai Kiado (1972).

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24410 PROPERTIES OF ELECTRONS AND HYDROGEN FORMATION IN GAMMA-IRRADIATED 2-METHYLTETRAHYDROFURAN GLASS. Teply, J.; Kiss, F.; Janovsky, I.; Vacek, K. (Nuclear Research Inst., Rez, Czech.). pp 271-277 of Proceedings of the third Tihany symposium on radiation chemistry. Vol. I. Dobo, J. (ed.). Budapest; Akademiai Kiado (1972).

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24411 ROLE OF CHEMICAL STRUCTURE IN THE RADIATION CHEMICAL DECOMPOSITION OF SATURATED-UNSATURATED HYDROCARBON MIXTURES. Foeldiak, G. (Inst. of Isotopes, Budapest). pp 279-286 of Proceedings of the Third Tihany symposium on radiation chemistry. Vol. I. Dobo, J. (ed.). Budapest; Akademiai Kiado (1972).

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24412 EFFECT OF π-BONDS ON THE RADIATION CHEMICAL DECOMPOSITION OF ALKENES. Cserep, Gy.; Foeldiak, G. (Inst. of Isotopes, Budapest). pp 287-299 of Proceedings of the third Tihany symposium on radiation chemistry. Vol. I. Dobo, J. (ed.). Budapest; Akademiai Kiado (1972).

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24413 INFLUENCE OF THE CYCLIC STRUCTURE OF LIQUID HYDROCARBONS ON REACTIONS DURING RADIOLYSIS. Wojnarovits, L.; Foeldiak, G. (Inst. of Isotopes, Budapest). pp 301-309 of Proceedings of the third Tihany symposium on radiation chemistry. Vol. I. Dobo, J. (ed.). Budapest; Akademiai Kiado (1972).

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24414 INTERACTIONS BETWEEN COMPONENTS OF ALKANE-CYCLOALKANE-ISOALKANE SYSTEMS DURING RADIOLYSIS. Gyoergy, I.; Horvath, Zs.; Wojnarovits, L.; Foeldiak, G. (Inst. of Isotopes, Budapest). pp 311-321 of Proceedings of the third Tihany symposium on radiation chemistry. Vol. I. Dobo, J. (ed.). Budapest; Akademiai Kiado (1972).

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24415 STUDIES ON IODINE AS A SCAVENGER OF RADIOLYTIC PRODUCTS IN IRRADIATED LIQUID HYDROCARBONS. Bonifacic, M.; Vlatkovic, M. (Inst. Rudjer Boskovic, Zagreb). pp 337-346 of Proceedings of the third Tihany symposium on radiation chemistry. Vol. I. Dobo, J. (ed.). Budapest; Akademiai Kiado (1972).

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24416 γ-RADIOLYSIS OF CYCLOHEXANE IN THE PRESENCE OF THIOL AND DISULFIDE. Madeleine Harris, L. B. G.; Esser, J.; Stone, J. A. (Queen's Univ., Kingston, Ont.). pp 347-356 of Proceedings of the third Tihany symposium on radiation chemistry. Vol. I. Dobo, J. (ed.). Budapest; Akademiai Kiado (1972).

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24417 STUDY OF γ-RAY-INDUCED CYCLOHEXANE RING SCISSION IN CONDENSED PHASES. Grachova, T. (Inst. of Petrochemical Synthesis, Moscow); Makarov, V. I.; Polak, L. S.; Avdonina, E. N. pp 357-369 of Proceedings of the third Tihany symposium on radiation chemistry. Vol. I. Dobo, J. (ed.). Budapest; Akademiai Kiado (1972).

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24418 RADIOLYSIS OF PERFLUOROMETHYLCYCLOHEXANE. Gehringer, P.; Krenmayr, P.; Proksch, E. (Reaktorzentrum, Seibersdorf, Vienna). pp 371-383 of Proceedings of the third Tihany symposium on radiation chemistry. Vol. I. Dobo, J. (ed.). Budapest; Akademiai Kiado (1972).

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24419 NATURE OF PARAMAGNETIC CENTERS IN ALIPHATIC THIOCYANATES AND THE DEPENDENCE OF THEIR RADIOCHEMICAL YIELD ON THE LENGTH OF THE HYDROCARBON CHAIN. Tushurashvili, R. G.; Dapkviashvili, A. G.; Panchvidze, M. V.; Khidesheli, G. I. (Inst. of Inorganic Chemistry and Electrochemistry, Tbilisi, USSR). pp 385-394 of Proceedings of the third Tihany symposium on radiation chemistry. Vol. I. Dobo, J. (ed.). Budapest; Akademiai Kiado (1972).

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24420 CHEMICAL REACTIONS OF b-Ps ORGANIC SOLIDS. Ito, Y.; Tabata, Y. (Tokyo Univ.). pp 395-405 of Proceedings of the third Tihany symposium on radiation chemistry. Vol. I. Dobo, J. (ed.). Budapest; Akademiai Kiado (1972).

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24421 RADICAL FORMATION IN HETEROGENEOUS SYSTEMS HYDROCARBONS/SILICA GEL. Kinell, P. O. (Swedish Research Council's Lab., Nykoeping). pp 407-419 of Proceedings of the third Tihany symposium on radiation chemistry. Vol. 1. Dobo, J. (ed.). Budapest; Akademiai Kiado (1972).

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24422 STRUCTURE OF PRIMARY RADICALS AND THEIR CONVERSION IN X-IRRADIATED SOLID AMINO ACIDS BY ESR. Lassmann, G.; Damerau, W. (Research Center for Molecular Biology and Medicine, Berlin). pp 421-429 of Proceedings of the third Tihany symposium on radiation chemistry. Vol. I. Dobo, J. (ed.). Budapest; Akademiai Kiado (1972).

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24423 ESR STUDY OF GAMMA-IRRADIATED SINGLE CRYSTAL OF 2-THIO-5,6-DIHYDROURACIL. Herak, J. N. (Inst. Rudjer Boskovic, Zagreb). pp 431-440 of Proceedings of the third Tihany symposium on radiation chemistry. Vol. I. Dobo, J. (ed.). Budapest; Akademiai Kiado (1972).

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24424 FREE RADICAL DECAY IN γ-IRRADIATED ORGANIC CRYSTALS. Tolkachev, V. A. (Inst. of Chemical Kinetics and Combustion, Novosibirsk, USSR). pp 441-452 of Proceedings of the third Tihany symposium on radiation chemistry. Vol. I. Dobo, J. (ed.). Budapest; Akademiai Kiado (1972).

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24425 RADIATION- AND PHOTO-INDUCED IONIC POLYMERIZATION. Hayashi, K. (Hokkaido Univ., Sapporo); Irie, M.; Hayashi, Kanae pp 453-462 of Proceedings of the third Tihany symposium on radiation chemistry. Vol. I. Dobo, J. (ed.). Budapest; Akademiai Kiado (1972).

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24426 RADIATION POLYMERIZATION IN SOLID STATE AT LOW TEMPERATURES. Gerasimov, G. N.; Smirnov, A. D.; Kotin, E. B. (Inst. of Physical Chemistry, Moscow). pp 463-472 of Proceedings of the third Tihany symposium on radiation chemistry. Vol. I. Dobo, J. (ed.). Budapest; Akademiai Kiado (1972).

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24427 SOLID STATE POLYMERIZATION OF METHYL METHACRYLATE. Tabata, Y.; Ito, Y.; Mori, K.; Oshima, K. (Tokyo Univ.). pp 473-484 of Proceedings of the third Tihany symposium on radiation chemistry. Vol. I. Dobo, J. (ed.). Budapest; Akademiai Kiado (1972).

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24428 MECHANISM OF CHAIN PROPAGATION AND TERMINATION IN RADIATION-INDUCED SOLID STATE POST-POLYMERIZATION. Kaplan, A. M.; Mikhailov, A. I.; Kiryukhin, D. P.; Barkalov, I. M.; Goldanskii, V. I. (Inst. of Chemical Physics, Moscow). pp 485-492 of Proceedings of the third Tihany symposium on radiation chemistry. Vol. I. Dobo, J. (ed.). Budapest; Akademiai Kiado (1972).

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24429 RADICAL MECHANISMS OF THE RADIATION POLYMERIZATION OF ACRYLIC ACID IN THE CRYSTALLINE STATE. Mikhailov, A. I.; Bolshakov, A. I.; Barkalov, I. M.; Goldanskii, V. I. (Inst. of Chemical Physics, Moscow). pp 493-502 of Proceedings of the third Tihany symposium on radiation chemistry. Vol. I. Dobo, J. (ed.). Budapest; Akademiai Kiado (1972).

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24430 POLYMERIZATION KINETICS OF SOLID FORMALDEHYDE IN GAMMA RADIATION FIELD. Barkalov, I. M.; Kiryukhin, D. P.; Kaplan, A. M.; Goldanskii, V. I. (Inst. of Chemical Physics, Moscow). pp 503-511 of Proceedings of the third Tihany symposium on radiation chemistry. Vol. I. Dobo, J. (ed.). Budapest; Akademiai Kiado (1972).

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24475 STRUCTURAL STUDY OF POLYETHYLENE-STYRENE GRAFT COPOLYMERS. Bezjak, A. (Inst. Rudjer Boskovic, Zagreb); Veksli, Z.; Tomaskovic, V.; Baric, M.; Dvornik, I.; Dobo, J. pp 1013-1023 of Proceedings of the third Tihany symposium on radiation chemistry. Vol. I. Dobo, J. (ed.). Budapest; Akademiai Kiado (1972).

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24477 RADIATION-INDUCED GRAFT COPOLYMERIZATION OF VINYL MONOMERS ONTO CELLULOSE. Sadykov, M. U.; Mirkamilova, G. M.; Karimova, Sh. N.; Mirkamilov, I. M.; Yunusov, M. Yu.; Isamukhamedova, I. I.; Vakhidov, N.; Azizov, U.; Razykov, K. Kh.; Usmanov, Kh. U. (Tashkent State Univ.). pp 1037-1048 of Proceedings of the third Tihany symposium on radiation chemistry. Vol. I. Dobo, J. (ed.). Budapest; Akademiai Kiado (1972).

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24479 RADIOTHERMOLUMINESCENCE METHOD FOR INVESTIGATING THE THERMAL AND RADIATION-INDUCED CROSSLINKING OF RUBBER MIXTURES. Nikol'skii, V. G.; Zlatkevich, L. Yu.; Borisov, V. A.; Kaplunov, M. Ya. (Inst. of Chemical Physics, Moscow). pp 1061-1068 of Proceedings of the third Tihany symposium on radiation chemistry. Vol. I. Dobo, J. (ed.). Budapest; Akademiai Kiado (1972).

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24481 FORMATION OF FREE RADICALS IN POLYMERS EXPOSED TO THE SIMULTANEOUS ACTION OF LIGHT AND γ-RADIATION. Milinchuk, V. K.; Zhdanov, G. S.; Pshezhetskii, S. Ya. (Inst. of Physical Chemistry, Moscow). pp 1077-1087 of Proceedings of the third Tihany symposium on radiation chemistry. Vol. I. Dobo, J. (ed.). Budapest; Akademiai Kiado (1972).

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Radiochemistry and Nuclear Chemistry

24482 (BARC-628) RADIOCHEMISTRY DIVISION ANNUAL PROGRESS REPORT FOR 1971. Iyer, R. H.; Ramaniah, M. V. (eds.) (Bhabha Atomic Research Centre, Bombay (India)). 1972. 190p. Dep. NTIS (U. S. Sales Only).

Separate abstracts were prepared for the seven sections presented. (DHM)

For abstracts of individual sections see: 24343, 24484, 24511-24513, and 26316.

Hot-Atom Chemistry

24483 EXPLODING LATTICE MODEL FOR HOT-ATOM REACTIONS IN SOLIDS. 1. Retention in Orthophosphates and Orthophosphites. Anselmo, V. C. (New Mexico Highlands Univ., Las Vegas). J. Inorg. Nucl. Chem.; 35: No. 4, 1069-1072 (Apr 1973).

A model for hot-atom reactions in solids is proposed from observations of retention in orthophosphate and orthophosphite salts. It is proposed that an exploded-lattice state is formed when an energetic phosphorus atom breaks through first the primary cage (tetrahedral arrangement of oxygen and/or hydrogen atoms) and then the secondary cage (of cations) effectively generating a zone of displaced atoms. A plot of (1 - R), where R is the retention, vs the mass of the cation shows a sharp break for masses greater than 30. Estimates are made for retention in the three energy regions that are defined. (auth)

Properties of Radioactive Materials

Refer also to abstracts 24345, 24588, 25026, 25085, and 25119.

24484 (BARC-628, pp 44-79) STRUCTURAL STUDIES. 1972.

Research progress is reported on solid complexes of uranyl β-diketones with long chain aliphatic sulfoxides; stability correlations and steric effects of synergistic complexes; x-ray structural studies of uranyl oxalate, and oxalato and acetoato complexes of actinides, and nonstoichiometric oxides of the lanthanides; calibration of Mettler thermoanalyzer; Moessbauer studies of some ilmenites; preparation of ^{145}Pm; fluorescence and absorption spectrum of Tb^{3+} ion in $LaBr_3$ crystal; energy-transfer studies in rare earth chelates, and EPR study of VO^{++} in $UO_2(NO_3)_2 \cdot 6\ H_2O$ single crystal. (DHM)

24485 (CONF-730402-6) THERMAL DECOMPOSITION OF BERKELIUM COMPOUNDS. Haire, R. G. (Oak Ridge National Lab., Tenn.). 1973. 10p. Dep. NTIS.

From 10th rare earth research conference; Carefree, Arizona, USA (30 Apr 1973).

The thermal decomposition of several Bk compounds was studied with 1-mg quantities of ^{249}Bk. Comparative studies were also done with selected lanthanide elements, employing the same quantities of material and the same preparatory methods. The decomposition of the nitrate, chloride, sulfate, and oxalate was studied in air, Ar, and H_2-Ar atmospheres. It was found that in atmospheres containing oxygen or when oxygen can be provided by the anion, the Bk behaved very similarly to Ce. In the absence of oxygen, there was a greater tendency for the Bk to behave like Tb. From the decomposition of the hydrated salts, values can be assigned for the coordination number of Bk. (auth)

24486 (KFK-tr-421) REDUCTION OF MENDELEVIUM TO A VALENCY ONE CONDITION. (Joint Inst. for Nuclear Research, Dubna (USSR)). Translated by Rosemarie Corssen (Kernforschungszentrum, Karlsruhe, W. Ger.), from Russian JINR-6-6341. Dec 1972. 10p. (In German). Dep. NTIS (U. S. Sales Only).

The monovalent state of mendelevium was studied. A special test tube contained 0.5 ml ethanol with ^{256}Md, its daughter product ^{256}Fm, and about 50 mg $EuCl_3$. To this solution, 0.5 ml of 7 molar HCl in 96% ethanol and 25 mg of metallic magnesium were added. The Md content of the precipitate, as measured by spontaneous fission, was much smaller than expected. In a second series of experiments, the system $YbCl_2-YbCl_3$ was chosen instead of Eu. Ethanol containing CsCl was added during maximal ytterbium reduction. The CsCl precipitate contained the Md almost quantitatively. It was concluded that Md assumed the 1^+ oxidation state and formed isomorphic cocrystals with CsCl. The chemical properties of Md thus were similar to those of the heavy alkali metals. (HBG)

24487 (LF-45, pp 7-12) APPLICATION OF A HIGH TEMPERATURE GRAPHITE FURNACE FOR THE PRODUCTION OF SUBMICRON AEROSOL PARTICLES BY VAPORIZATION OF CERIC OXIDE. Light, M. E. Nov. 1972.

In fission product inhalation program.

A high temperature graphite furnace was evaluated as a thermal source to produce submicron aerosol particles from oxides of metals. The effect of temperature, diluting air, and collection chamber size upon formation of chains and agglomerates formed by vaporization of CeO_2 was studied. The formation of agglomerates and chains could be reduced and in some cases kept from forming by introducing diluting air and storing the aerosol immediately downstream from the furnace in a large chamber. The particles produced ranged in size from 0.001 μm to 0.3 μm physical diameter. (auth)

24488 (LF-45, pp 21-28) PRODUCTION OF MONODISPERSE AEROSOLS OF $^{239}PuO_2$ LABELED WITH ^{51}Cr. Raabe, O. G.; Boyd, H. A.; Mewhinney, J. A.; Miglio, J. J.; Wilkinson, C. J. Nov 1972.

In fission product inhalation program.

Monodisperse aerosols of $^{239}PuO_2$ labeled with ^{51}Cr have been prepared by: nebulizing an aqueous preparation containing both ^{239}Pu and a small mass of ^{51}Cr, heat treating the resulting aerosol to form a polydisperse aerosol of particles of $^{239}PuO_2$ labeled with ^{51}Cr, separation and collection of the particles into monodisperse size groups using the Lovelace Aerosol Particle Separator, and resuspending the monodisperse particles on small segments of the collection foil from the particle separator to provide aqueous suspensions for nebulization to form monodisperse aerosols or for other studies. During an 11½ hour continuous separation, monodisperse particles of $^{239}PuO_2$ labeled with ^{51}Cr were prepared. In vitro solubility studies showed that the monodisperse aerosols had a readily soluble fraction possibly associated with small contaminating particles of ^{51}Cr in that over 11% of the ^{51}Cr was readily dissolved in the first two days of the dissolution study. Near the end of the 24-day study, dissolution stabilized somewhat and the PuO_2 dissolution based on the ^{51}Cr label had a rate constant of specific solubility of about 6.8×10^{-8} gm/cm^2-day as compared to a value of about 1.9×10^{-10} gm/cm^2-day based on dissolved plutonium. Clearly, the ^{51}Cr was leaving the plutonium particles much faster than they were dissolving with a half-time of about 2 years as compared to about 700 years for the plutonium particles themselves. (auth)

24489 (MLM-2010) DISSOLUTION OF HIGH-FIRED PLUTONIUM OXIDE. Woltermann, H. A.; Ulrick, T. L.; Antion, D. (Mound Lab., Miamisburg, Ohio). 9 Mar 1973. Contract AT-33-1-Gen-53. 9p. Dep. NTIS $3.00.

A method of dissolution of high-fired plutonium oxide using a Teflon-lined acid-digestion bomb permits a more rapid and efficient dissolution than previously obtained in a Teflon breaker. Analytical results subsequent to dissolution indicate that the acid-digestion bomb is far superior to the Teflon breaker method in quantitative handling of plutonium oxide samples. (auth)

24490 (UCRL-73843) REDUCTION STUDIES OF TRIVALENT CALIFORNIUM AND EINSTEINUM. Hulet, E. K.; Wild, J. F.; Lougheed, R. W.; Hayes, W. N. (California Univ., Livermore. Lawrence Livermore Lab.). Sep 1972. 12p. Dep. NTIS.

Binding energies of the 5f electrons rapidly increase as the end of the actinide series is approached as shown by the stability of the (II) oxidation state of Md and No. To determine if this stability extends to lower members of the actinides, experiments were made to prepare anhydrous compounds of divalent Cf and Es. Among the simple compounds, the diiodes are expected to be the most stable. The reduction of CfI_3 with hydrogen at 550 to 650°C appears partially successful in producing CfI_2. X-ray powder diffraction data show the major lines expected of a hexagonal CfI_2-type structure in addition to the known lines belonging to CfI_3. Experiments are continuing to prepare a pure divalent phase for positive identification. The observation of color changes also indicates that CfI_3 is partially dissociated to CfI_2 upon heating the triiodide above 550°C in a vacuum. The outcome of attempts to prepare Es (II) oxide by hydrogen reduction of the sesquioxide at high temperatures was inconclusive. The crystal structure was destroyed too rapidly by the α radiation of ^{253}Es to obtain x-ray diffraction data. No annealing of the radiation damage was noted in x-ray diffraction patterns taken at 600°C. (auth)

24491 CORRELATION BETWEEN ION EXCHANGE MEMBRANE CONDUCTIVITY AND THE FREQUENCY EFFECT. Wallace, R. A. (Stanford Univ., CA). J. Appl. Polym. Sci.; 17: No. 1, 309-313(Jan 1973).

Measurements of the electrical conductivity-frequency variations of a sulfonated polystyrene cation exchange membrane fully saturated by a multivalent cation (Na^+, Mg^{2+}, Zn^{2+}, Fe^{3+}, La^{3+}, or Th^{4+}) and immersed in a 0.10N NaCl supporting electrolyte are reported. Electrical conductivities of each membrane in its cationic form were correlated to its frequency effect. The exhibited frequency dependence was accounted for by differences in mobilities of ions and in the electrical double layer of the membrane-0.10N NaCl solution. (auth)

24492 ^{248}Cm-OXIDE SYSTEM. Turcotte, R. P.; Chikalla, T. D.; Eyring, L. (Battelle-Northwest, Richland, Wash.). J. Inorg. Nucl. Chem.; 35: No. 3, 809-816(Mar 1973).

Isobaric oxygen dissociation pressure measurements were performed on 0.68 mg of $^{248}CmO_2$. Though the α activity of ^{248}Cm is less by a factor of about 20,000 than that of ^{244}Cm, the oxide systems of curium based on these two isotopes show only slight differences in phase behavior attributable to the vastly differing levels of radioactivity. This is manifested principally as a destabilization of low temperature phases $CmO_{2-x}(\alpha)$ and $CmO_{1.83}(\delta)$ in the ^{244}Cm oxide system. A phase highly resistant to oxidation, most likely monoclinic (B) Cm_2O_3, appears at temperatures as low as 840°C. (auth)

24493 PREPARATION OF ^{186}Re-LABELLED RHENIUM SULPHIDE FOR USE IN SYNOVITIS THERAPY. Bardy, A.; Beydon, J.; Hegesippe, M. (CEN de Saclay, Gif-sur-Yvette, France). Int. J. Appl. Radiat. Isotop.; 24: No. 1, 57-60(Jan 1973). (In French).

A method of preparing ^{186}Re-labeled colloidal rhenium sulfide for therapeutic use was developed. The colloid is stable and has a rhenium ion content less than 0.5% at the moment of use. The micelles are about 50 to 100 Å in size. The sterility, toxicity, and isotonicity controls are satisfactory. (UK)

24494 COMPARATIVE STABILITY OF SULFATE COMPLEXES OF SOME RARE EARTH AND ACTINIDE ELEMENTS. Stepanov, A. V. Zh. Neorg. Khim.; 18: No. 2, 371-374(Feb 1973). (In Russian).

Stability constants were determined for the nonsulfate complex of Cm at an ionic strength of 0.1 at 15, 25, and 35°C. The ratios for the primary stability constants of sulfate complexes of La, Ce, Pm, Eu, Tb, Tm, Yb, Y, and Ac to the correspond-

ing constant for Cm were determined. The value of $\Delta \log \beta_1$ was studied as a function of the ion radius of the elements. The monosulfate complexes of the lanthanides were predominantly outer-sphere compounds. (tr-auth)

24495 PREPARATION, CHARACTERIZATION, AND THERMAL DECOMPOSITION OF $Tl_2UO_2(C_2O_4)_2 \cdot 2H_2O$. Jayadevan, N. C. Dias, R. M. A.; Chackraburtty, D. M. (Bhabha Atomic Research Centre, Bombay). J. Inorg. Nucl. Chem.; 35: No. 3, 1037-1040 (Mar 1973).

Heating a mixture of U_3O_8 and Tl_2CO_3 at 600°C is reported to give three oxides of composition Tl_2UO_4, $Tl_2U_2O_7$ and $Tl_2U_3O_{10}$ all of which contain hexavalent uranium. Single phases of mixed metal oxides which are difficult to obtain by the dry method of heating component oxides can easily be prepared by the thermal decomposition of their oxalate complexes. A report is presented of a study of the thermal decomposition of thallium bisoxalatodioxouranate(VI). (auth)

24496 KINETICS OF THE OXIDATION OF URANIUM(IV) IONS BY HALOGENS IN AQUEOUS SOLUTION. Pt. 1. Iodine and Bromine. Adegite, A.; Ford-Smith, M. H. (Sussex Univ., Brighton, Eng.). J. Chem. Soc., Dalton Trans.; No. 2, 134-138 (1973).

The reaction $U^{4+} + 2H_2O + I_2 \rightarrow UO_2^{2+} + 2I^- + 4H^+$ obeys the rate expression $-d[I_2]/dt = k_2'[U^{IV}][I_2][H^+]^{-2}$, with $k_2' = 8.9 \times 10^{-4}$ l mol^{-1} s^{-1} at 40°C and I = 1.0M where I is ionic strength. The rate of reaction decreases with increasing $[I^-]$ and the results fit the expression $-d[I_2]/dt = k_8[U^{IV}][I_2] + k_9[U^{IV}][I_2^-]$, where $k_8 = 9.9 \times 10^{-2}$ and $k_9 = 1.9 \times 10^{-2}$ l mol^{-1} s^{-1} at 40°C, $[H^+] = 0.10$M, and I = 1.0M. Activation energies and entropies of activation for the two paths are: for k_8, $E_a = 17.3 \pm 2.6$ kcal mol^{-1}, $\Delta S^{\ddagger} = -9.1 \pm 1.5$ cal K^{-1} mol^{-1}; and for k_9, $E_a = 19.9 \pm 1.2$ kcal mol^{-1}, $\Delta S^{\ddagger} = -4.6 \pm 0.3$ cal K^{-1} mol^{-1}. The effect on the rate of added SO_4^{2-}, F^-, Cl^-, Br^-, N_3^-, and NCO^- ions is also reported. The reaction $U^{4+} + Br_2 + 2H_2O \rightarrow UO_2^{2+} + 2Br^- + 4H^+$ was confirmed as obeying the rate expression $-d[U^{IV}]/dt = k_3[U^{IV}][Br_2]$, with $k_3 = 1.16 \times 10^{-3}$ l mol^{-1} s^{-1} at 25°C, $[H^+] = 0.70$M, and I = 3.0M. The activation energy and entropy for this reaction are $E_a = 23.3 \pm 5.0$ kcal mol^{-1} and $\Delta S^{\ddagger} = 1.99 \pm 0.05$ cal K^{-1} mol^{-1}. (auth)

24497 KINETICS OF THE OXIDATION OF URANIUM(IV) IONS BY HALOGENS IN AQUEOUS SOLUTION. Pt. 2. Chlorine. Adegite, A.; Ford-Smith, M. H. (Sussex Univ., Brighton, Eng). J. Chem. Soc., Dalton Trans.; No. 2, 138-143(1973).

The rate of the reaction of $U^{4+} + Cl_2 + 2H_2O \rightarrow UO_2^{2+} + 2Cl^- + 4H^+$ is shown to obey the rate law $-d\,U^{IV}/dt = k\,U^{IV}\,Cl_2\,H^{\pm 2}$. The rate constant decreases with increasing Cl^- and the data are interpreted in terms of a mechanism involving two paths, $U(OH)_2^{2+} + Cl_2$ and $U(OH)^{3+} + HOCl$. Rate constants and Arrhenius parameters are calculated for the two paths. (auth)

24498 ULTRAVIOLET AND INFRARED SPECTRA OF TETRAKIS (CUPFERRONATO) AND (NEOCUPFERRONATO) URANIUM(IV). Yoshimura, T.; Miyake, C.; Imoto, S. Technol. Rep. Osaka Univ.; 22: 791-802(Oct 1972).

The cupferronate and neocupferronate of tetravalent uranium ion were carefully prepared and the ir, uv, and visible spectra were measured. These spectra were identified from comparison with the ir and uv spectra of cupferron and neocupferron, and compared with those of the cupferronates and neocupferronates of other tetravalent metal ions (Ti(IV), Zr(IV), Sn(IV), Hf(IV), Ce(IV), Th(IV)). The solvent effect on uv spectra was measured for tetrakis (cupferronato) uranium(IV) and confirmed to be in accord with that on uv spectra of cupferron. (auth)

24499 BASIC FORMATE OF URANIUM(VI). Sampath, S.; Aravamudan, G. (Indian Inst. of Tech., Madras). J. Inorg. Nucl. Chem.; 35: No. 4, 1377-1379(Apr 1973).

The preparation is reported of a basic formate of uranium(VI) having the composition $UO_2(OH)(HCOO)H_2O$. It gave a good x-ray powder spectrum but the reflections could not be indexed on the basis of highly symmetrical crystal systems. The lattice parameters are stated. The ir spectra indicated that the compound has $-UO_2-$ groups with uranium atoms linked to each other through hydroxyl, water, and formate bridges. The compound was further characterized by thermal gravimetric analysis and differential thermal analysis. (UK)

24500 EVIDENCE FOR ERRORS IN THE PUBLISHED ENTHALPIES OF FORMATION: $\Delta_f H^0(Am^{3+}, aq)$ AND $\Delta_f H^0(AmCl_3, c)$. The Molten Salt Extraction of Americium from Plutonium Metal. Ryan, J. L. (Battelle-Northwest, Richland, WA). J. Chem. Thermodyn.; 5: No. 1, 153-154(Jan 1973).

It has been reported that the equilibrium constant for the extraction of Am(1) into molten NaCl + KCl + $PuCl_3$ from Pu(1) metal is a factor of 10^3 lower at 1000°K than that predicted by the thermodynamic data for $AmCl_3$ and $PuCl_3$. There is no reason to doubt the Pu thermodynamic data, but recent work indicates that the Am data are suspect. Reasons are given for considering that the published enthalpies of formation, -251.3 kcal$_{th}$ mol^{-1} for $\Delta_f H^0(AmCl_3, c)$ and (-163.2 ± 2.7) kcal$_{th}$ mol^{-1} for $\Delta_f H^0(Am^{3+}, aq)$ are incorrect, and for proposing values of $\Delta_f H^0(AmCl_3, c) = -237$ kcal$_{th}$ mol^{-1} and $\Delta_f H^0(Am^{3+}, aq) = -149$ kcal$_{th}$ mol^{-1} as negative limits. It is stated that since the preparation of this paper, other workers have reported a remeasurement of $\Delta_f H^0(Am^{3+}, aq)$ resulting in a value of $-(147.4 \pm 0.3)$ kcal$_{th}$ mol^{-1}. (UK)

24501 NEW METHOD FOR LABELLING PROTEIN HORMONES WITH RADIOIODINE FOR USE IN THE RADIOIMMUNOASSAY. Bolton, A. E.; Hunter, W. M. (Medical Research Council, Edinburgh). J. Endocrinol.; 55: No. 2, 30-31(Nov 1972).

A method of labeling protein hormones with ^{125}I is described that involves labeling the protein by conjugation with a radioiodinated acylating agent that obviates the disadvantages associated with the normal chloramine-T oxidation procedure. This method was used to label human growth hormone (170 μCi/g), human thyroid stimulating hormone (120 μCi/g), and human luteinizing hormone (50 μCi/g). The immunoreactivity of those hormone preparations prepared by the two methods was compared with that of unlabeled hormone and the reactivity of tracers prepared by both methods was tested in sensitive, specific radioimmunoassays. (UK)

Radioactive Waste Treatment

Refer also to abstracts 24357 and 24822.

24502 COLLECTION AND DECONTAMINATION OF INDUSTRIAL AND DOMESTIC SEWAGE POLLUTED WITH RADIOACTIVE DISCHARGES. Bagretsov, V. F.; Zakharov, S. I.; Metal'nikov, S. V. Gig. Sanit.; No. 12, 91-93(Dec 1972). (In Russian).

Radioactive waste waters from an atomic reactor institute were divided into three groups: salt-free water from the primary loop of the reactor and hold-up basins, waste waters from decontamination of plant and equipment, from laboratories and laundry, and sanitation wastes. The loop and basin waters are purified of corrosion products and radioactive elements by distillation. The distillate is sent back for re-use, and the pot residues are placed in a container also used to collect waters of the second group. For this there are available three subterranean containers of 2,000 m^3 capacity each, and a large, deep formation in the earth. Escape of contamination into the environment is thus avoided. (KSW)

24503 RETENTION OF CERTAIN RADIOACTIVE IONS BY NATURAL INORGANIC MACROMOLECULES FROM SUSPENSIONS FROM SURFACE BASINS AND FROM CERTAIN ACTIVATED FULLER'S EARTHS. Furnica, G. H. (Inst. of Hygiene, Bucharest); Voicu, V. Rev. Roum. Chim.; 15: No. 7, 1087-1096(Jul 1970). (In French).

The varying retention of the isotopes ^{22}Na, ^{85}Sr, ^{110}Ag, ^{134}Cs, ^{65}Zn, ^{59}Fe, and ^{131}I dissolved in water by the slime taken from the Dimbovitza River, Bucharest, was studied, namely 15% Na, 45% Sr, 37% I, 97% Zn, 95% Fe, and 98% Cs. On elution of the slime that had fixed the ^{22}Na, ^{85}Sr, and ^{110}Ag an ion exchange phenomenon between the radioactive ions and the natural product was observed. The sand retains separately: 3.6% Na, 22% Ag, 72% Zn, 8.8% I, 99% Cs, 93% Sr, and 94% Fe. Treatment of sand with 5% HNO_3 or 10% HCl modifies the retention capacity of the radioactive ions. In the case of identical determinations with bentonites of the montmorillonite type, a larger retention with respect to cesium and a smaller one with respect to sodium were observed. (tr-auth)

Radioisotope Production

Refer also to abstracts 25317, 25318, and 26316.

24504 (BNWL-1690) MARKET ANALYSIS OF THE FISSION PRODUCTS Rh, Pd, Ru, AND Tc. Clark, L. L.; Roberts, F. P.; Sheppard, J. C.; Kaser, J. D. (Battelle Pacific Northwest Labs., Richland, Wash.). Feb 1973. Contract AT(45-1)-1830. 35p. Dep. NTIS.

The market analysis of fission products Rh, Pd, Ru, and Tc was divided into two major areas. First, a study was done of the supply and demand characteristics; second, an economic analysis of the profitability of separating and marketing these fission products was performed. The supply and demand analysis considered the general market characteristics such as suppliers, the dependency of platinum metal supplied upon nickel and platinum demand, and the historic ratios of demand. A brief systems diagram outlined the multiple facets of the marketing problem. A mathematical model describing future consumption projections was outlined, and curves of consumption versus time were derived

for Pd, Rh, and Ru. This enabled us to project the time period when shortages might occur. The economic analysis consisted of defining a cost model using a present value analysis of net cash flows constructed to cover the period from 1975 to 2025. Various assumptions and costs were changed in the model to evaluate the effect on the value of the project. Ranges of profitability in terms of rate of return were calculated for various sets of assumptions. (auth)

24505 (DP-1302) CURIUM PROCESS DEVELOPMENT. II-2. Recovery of Curium and Americium by Solvent Extraction with Tertiary Amines. Prout, W. E.; Henry, H. E.; Holcomb, H. P.; Jenkins, W. J. (Du Pont de Nemours (E.I.) and Co., Aiken, S. C. Savannah River Lab.). Dec 1972. Contract AT(07-2)-1. 75p. Dep. NTIS $3.00.

A solvent extraction process for separating and purifying kilogram quantities of curium and americium from irradiated plutonium-aluminum alloy targets was adapted and demonstrated. The process was tested extensively in miniature solvent extraction equipment to obtain design data for a large pilot production facility that was installed and operated in shielded caves at Savannah River Laboratory. The process (Tramex) employs three cycles of solvent extraction with 30% tertiary amines in diethylbenzene. (auth)

24506 (DP-1308) ION EXCHANGE PROCESS FOR SEPARATING AMERICIUM AND CURIUM FROM IRRADIATED PLUTONIUM. Kelley, J. A. (Du Pont de Nemours (E.I.) and Co., Aiken, S. C. Savannah River Lab.). Nov 1972. Contract AT(07-2)-1. 40p. Dep. NTIS $3.00.

An ion exchange process was developed for separating americium and curium from each other and from fission products in a lanthanide (Ln)-actinide (An) concentrate containing a high Ln/An ratio and a significant amount of ^{242}Cm. The Ln-An mixture was produced by irradiating ^{239}Pu in the program to prepare higher actinide precursors of ^{252}Cf. (auth)

24507 THERAPEUTIC USE OF ISOTOPE COWS. Krasznasi, I. (SOTE, Budapest). Izotoptechnika; 15: No. 12, 610-618(Dec 1972). (In Hungarian).

The physics of isotope generators, exposure of the patient, and environmental contamination are discussed. (auth)

24508 CLINICAL APPLICATION OF ISOTOPE COWS. Fuezy, M. (Orszagos Onkologiai Intezet, Budapest). Izotoptechnika; 15: No. 12, 603-609(Dec 1972). (In Hungarian).

The advantages and disadvantages of $^{99}Mo-^{99m}Tc$ and $^{113}Sn-^{113m}In$ isotope generators are discussed. The diagnostic use of ^{99m}Tc and ^{113m}In compounds is also discussed. (auth)

24509 ISOTOPE ENRICHMENT PROCESS FOR LANTHANIDE AND ACTINIDE ELEMENTS. Campbell, D. O. (to United States Atomic Energy Commission). U. S. Patent 3,708,392. 2 Jan 1973. Filed date 22 Dec 1970. 8p.

A method of enriching lanthanide and actinide isotopes is reported. It involves loading at least one target lanthanide or actinide cation onto a finely divided particle of synthetic faujasite, heating the faujasite at a temperature in the range of 350° to 750°C to fix the cation, and irradiating the previously heated faujasite with a neutron source to induce a (n,γ) transmutation reaction. Transmutation products having an atomic number greater than the irradiated target cation are relatively eluted. (Official Gazette)

Reactor Fuel Reprocessing

Refer also to abstract 24589.

24510 (ANL-7968) DEVELOPMENT AND PERFORMANCE OF A HIGH SPEED, LONG-ROTOR CENTRIFUGAL CONTACTOR FOR APPLICATION TO REPROCESSING LMFBR FUELS. Bernstein, G. J.; Grosvenor, D. E.; Lenc, J. F.; Levitz, N. M. (Argonne National Lab., Ill.). Jan 1973. Contract W-31-109-eng-38. 52p. Dep. NTIS. AT $3.00.

A centrifugal contactor with a high length-to-diameter rotor was developed and successfully tested. It is designed to be dimensionally safe for nuclear criticality when solutions having high concentrations of plutonium are processed in it. Mechanical and hydraulic performance was excellent. By close attention to critical-speed considerations during design and careful fabrication to the required tolerances, essentially all vibrations in the high-speed rotor were eliminated. By proper selection of mixing paddle size and mixing chamber dimensions, problems in flow surging were eliminated. Extraction tests were made with uranyl nitrate and 30% tributyl phosphate in n-dodecane. Essentially 100% stage efficiency was achieved readily. A bank of contactors of the size tested could easily process 1 tonne/day of mixed uranium-plutonium reactor fuel or plutonium alone. In tests to evaluate any effects on contactor operability of finely divided solids in the feed solutions, no operating difficulties were encountered. (auth)

24511 (BARC-628, pp 1-43) SOLUTION AND RADIATION CHEMISTRY. 1972.

Research progress is reported on synergistic extraction of uranyl ions, extraction of trivalent lanthanides from thiocyanate by neutral organophosphorous extractants, studies on complexes of lanthanides, radiolysis of Pu(III)/(IV) system in hydrochloric acid solution, radiolysis of Pu(III) in nitric acid solution, radiation chemistry of nitric acid, two-phase radiolysis and the effect of radiation on the distribution coefficients of uranium and plutonium, and flash photolysis of sulfanilamide and other p-substituted anilines. (DHM)

24512 (BARC-628, pp 117-140) PROCESS CHEMISTRY. 1972.

Research progress is reported on the recovery of ^{237}Np from irradiated uranium fuels; on-line analysis of fuel reprocessing streams (monitoring of fission products, and neutron monitoring for plutonium); production of transplutonium from spent fuels; and x-ray fluorescence analysis of actinide elements in solutions. (DHM)

24513 (BARC-628, pp 150-173) ANALYTICAL CHEMISTRY AND MISCELLANEOUS SERVICES. 1972.

Research progress is reported on mass spectrometric determination of $^{235}U/^{238}U$ isotopic ratio in NBS standard sample; isotope dilution method for input accountability in a reprocessing plant; fuel burnup measurements; determination of ^{235}U content of natural and depleted uranium samples by fission track method; analysis of PuO_2 for auditing; analysis of some common impurities in high-purity selenium by emission spectroscopy; and new radiochemical methods for separation of Cu and heavy rare earth elements from fission products. (DHM)

24514 (BARC-636) EXTRACTION OF NEPTUNIUM BY TRILAURYLAMINE. Patil, S. K.; Swarup, R.; Ramaniah, M. V.; Srinivasan, N. (Bhabha Atomic Research Centre, Bombay (India)). 1972. 19p. Dep. NTIS (U. S. Sales Only) $3.00.

Optimum conditions for the extraction of neptunium using trilaurylamine (TLA), indexed as tridodecylamine, were studied. Experiments were carried out on the extraction of Np(IV) into 20% TLA in Solvesso-100. The dependence of the extraction of Np(IV) on nitric acid concentration of from 1 to 8M, neptunium concentration of from 1 to 25 μg/ml, and uranium concentration ranging from 0 to 300 mg/ml, was studied. The extraction of Np(IV) from 3M nitric acid using varying concentrations of TLA was studied and the log-log plot of distribution coefficient vs TLA concentration was found to be a straight line with slope 2. The effect of the diluent on the extraction of Np(IV) into TLA was also studied. The stripping of neptunium from the TLA phase was found to be quite satisfactory with a mixture of 1.5M sulfuric acid and 0.5 M nitric acid, 1M formic or acetic acid, and 0.5M perchloric acid. (auth)

24515 (ORNL-TM-3772) EFFECTIVE THERMAL CONDUCTIVITY OF SHEARED PROTOTYPE LMFBR FUELS. Clinton, S. D.; Cox, R. L. (Oak Ridge National Lab., Tenn.). Feb 1973. Contract W-7405-eng-26. 33p. AT $4.00.

During the recovery of uranium and plutonium from irradiated LMFBR fuels by the mechanical shear-leach and aqueous Purex process, the volume of accumulated sheared fuel may be restricted by heat transfer limitations. The calculation of temperature gradients within a given volume of spent sheared fuels requires a knowledge of the effective thermal conductivity of the chopped fuel pieces. The effective thermal conductivities of 11 prototype systems were measured experimentally as a function of temperature. The experimental measurements were made at steady-state conditions using the technique of radial heat flow in a hollow cylinder. The prototype sheared systems ranged from metal-clad porcelain or unirradiated urania to empty stainless steel hulls in either an argon or air atmosphere. The measured thermal conductivities for each system could be correlated as an exponential function of temperature with an average deviation of only ±4.1% over the temperature range 200 to 1400°F. For stainless-steel-clad urania pellets that simulate sheared fuel from the LMFBR core region (0.305 in. diam by 1 in. long), the expression for the effective thermal conductivity was as follows: $k(Btu/hr\text{-}ft\text{-}°F) = 0.109e^{0.00168T(°F)}$. (auth)

24516 METHOD FOR THE PURIFICATION AND RECOVERY OF TRIBUTYL PHOSPHATE USED IN REPROCESSING NUCLEAR FUEL. Schulz, W. W. (to United States Atomic Energy Commission). U. S. Patent 3,708,508. 2 Jan 1973. Filed date 9 Apr 1971. 14p.

Tributyl phosphate solutions used in reprocessing nuclear fuel are purified and removed by passing them through a bed of par-

ticles of a macroreticular anion or cation exchange resin. The chemical and radiolytic degradation products and fission products present in the used solution are adsorbed on the resin. The tributyl phosphate used as extractant may be mixed with a diluent, e.g., C_{10} to C_{14} n-paraffins. Utilization of a macroreticular resin bed may eliminate the need to wash the tributyl phosphate extractant with large volumes of dilute Na_2CO_3 solution and thus avoids generation and disposal of a large volume of radioactive waste. (Official Gazette)

24517 METHOD FOR PREPARING HIGH PURITY ^{233}U. Bell, M. J.; Whatley, M. E. (to United States Atomic Energy Commission). U. S. Patent 3,714,322. 30 Jan 1973. Filed date 10 Jun 1970. 4p.

A method for preparing high-purity ^{233}U is reported. Molten salt reactor fuels containing protactinium isotopes are processed in a series of at least two hold-up tanks wherein in the first tank, decay of ^{232}Pa to ^{232}U is permitted to a preselected value, and the ^{232}U is removed by subsequent fluorination. In the second tank, decay of ^{233}Pa to ^{233}U is permitted to a preselected value and the ^{233}U, which is highly depleted in ^{232}U, is recovered by subsequent fluorination. (Official Gazette)

24518 METHOD OF REMOVING CARBON FROM NUCLEAR FUEL ELEMENTS IN A CLOSED SYSTEM. Dolci, G.; Renzoni, R. (Snam Progetti SpA). U. S. Patent 3,714,323. 30 Jan 1973. Priority date 21 Jan 1969, Italy. 6p.

Methods are described for eliminating carbon from nuclear fuel elements in their reprocessing in a closed system. In one embodiment, the carbon is reacted with carbon dioxide to form carbon monoxide in an attack zone which is maintained at a temperature of about 1000°C. The carbon monoxide is then caused to flow to a regeneration zone which is maintained at a lower temperature so that a reverse reaction occurs which converts the carbon monoxide into carbon dioxide and regenerated carbon, the carbon dioxide flows back to the attack zone leaving the regenerated carbon behind in the regeneration zone. (Official Gazette)

ENGINEERING

Energy Conversion

24519 VENETIAN-BLIND DIRECT ENERGY CONVERTER FOR FUSION REACTORS. Moir, R. W.; Barr, W. L. (Univ. of California, Livermore). Nucl. Fusion; 13: No. 1, 35-45(Jan 1973).

A new direct energy conversion technique that uses the angular-dependent transmission of ribbon grids, which resemble Venetian blinds, to recover the energy of particles leaking out of a fusion reactor is discussed. This converter works well, even to energies as low as 10 keV, because of its excellent space-charge handling ability. This low-energy operating range makes direct energy conversion possible on closed confinement devices; operation at about 100 keV might be useful on open confinement devices. Energy recovery efficiencies of 60 to 70% are predicted. Examples are presented in which a direct energy converter with efficiencies in this range, when viewed as a topping cycle to a thermal converter, could considerably improve the reactor prospects of both open- and closed-field-line confinement schemes. (auth)

24520 STUDY OF SILICON CARBIDE ELECTRODES FOR AN OPEN-CYCLE MAGNETOHYDRODYNAMIC GENERATOR. Zelikson, Yu. M.; Reshetov, E. P.; Flid, B. D.; Vinogradov, Yu. A. pp 98-110 of Magnitogidrodinam. Metod Poluchenlya Elektroenergii. Vypusk 3. Moscow; Energiya (1972). (In Russian).

Results are presented from a study of silicon carbide electrodes in a device simulating the conditions in an open-cycle magnetohydrodynamic generator channel. Data are presented on the effects of the plasma composition on the nature of the electrode processes. A study was made of the effects of the potassium additive concentration on the shape of the volt-ampere and sounding characteristics. The relation is presented for the cathode drop as a function of current at different potassium concentrations in the flow. It was established that with a potassium concentration of 0.3% and more there are in practice no cathode drops on the silicon carbide electrodes at $T_{el} \geq 1{,}350°C$. A relation was found for the limiting distributed discharge currents as a function of the electrode temperatures. The experimental values of these currents in the electrode temperature range of 1,350 to 1,500°C coincide satisfactorily with the ones calculated by the Richardson formula for A-120 $A/(cm^2 \cdot deg^2)$ and $\phi_{eff} = 2.7$ electron volts. The dependence of the mean erosion rate of the electrodes on the temperature and current density was defined. It was demonstrated that at an electrode temperature of 1,500°C the erosion does not in practice depend on the current density. (JPRS)

24521 PHYSICAL-CHEMICAL BEHAVIOR OF CERAMIC $ZrO_2-Y_2O_3$ AND ZrO_2-CeO_2 MAGNETOHYDRODYNAMIC GENERATOR ELECTRODES. Gokhshtein, Ya. P.; Safonov, A. A.; Lyubimov, V. D. pp 328-347 of Magnitogidrodinam. Metod Poluchenlya Elektroenergii. Moscow; Energiya (1972). (In Russian).

The multisounding method was used to study the effects of the oxygen partial pressure in argon on the physicochemical processes in $ZrO_2-Y_2O_3$ ceramic on passage of a current through it. It was demonstrated that during the course of the electrochemical processes on the current leads and in the reduced zirconium dioxide (black zircon), the linear relation between the potential difference and the length of the $ZrO_2-Y_2O_3$ system samples is distorted. The degree of distortion of the curves depends on the oxygen content in the argon. On passage of a current with a density of 2 to 3 A/cm^2 through a refractory electrode made of $ZrO_2-Y_2O_3$ ceramic, its service life is limited to a few hours. The process of cracking of the specimens begins on the cathode. A study was made of the physicochemical properties of ZrO_2-CeO_2 ceramic. It was demonstrated that zirconium dioxide and cerium dioxide ceramic is a semiconductor with mixed conductivity. With an increase in the CeO_2 content in the composition, the electron component of the conductivity increases. The number of ion transfers is defined for different compositions of cerium dioxide and zirconium dioxide, and the volt-ampere characteristics are obtained for them. It is demonstrated that the 0.75 CeO_2-0.25 ZrO_2 specimens in atmospheric air have maximum electron conductivity and maintain a current of 2 to 3 A/cm^2 for a prolonged period at 1,670°K without disintegration. (JPRS)

Facilities and Equipment

Refer also to abstracts 24780, 24917, 24993, 25094, 25153, 25158, and 26031.

24522 (LF-45, pp 1-6) OPERATING CHARACTERISTICS OF TWO COMPRESSED AIR NEBULIZERS USED IN INHALATION EXPERIMENTS. Raabe, O. G. Nov 1972.

In fission product inhalation program.

Nebulizers operated with compressed air are conveniently used for generating radioactive aerosols of both relatively soluble and relatively insoluble forms from aqueous solutions and suspensions for inhalation experiments. The Lovelace nebulizer and the Retec nebulizer are two which have been in use in this program. Selected operating characteristics of representatives of each of these nebulizers have been studied to determine the output of usable aerosol, volumetric rate of air required, droplet size distribution of usable aerosol, and rate of evaporation of water which is not associated with the aerosol. The Lovelace nebulizer has a basic aerosol output of about 50 μl/min of aerosol in an airflow of about 1.3 l/min at an operating pressure of 20 psig. The Retec nebulizer has a basic aerosol output of about 200 μl/min in about 6 l/min at an operating pressure of 20 psig. The droplet distributions for these two nebulizers were similar and in the respirable size range; the largest droplets had a volume median diameter of 6.9 μm and geometric standard deviation of 1.7 from the Lovelace nebulizer operating at 20 psig. (auth)

24523 (RISO-M-1564) DESCRIPTION OF A MODEL OF A U-TUBE STEAM GENERATOR. la Cour Christensen, P. (Danish Atomic Energy Commission, Risoe. Research Establishment). Jan 1973. 44p. Dep. NTIS (U. S. Sales Only) $4.25.

A one-dimensional model of a U-tube steam generator is described. The main emphasis is placed on the derivation of the equations and a discussion of the problem arising by a pure digital and a hybrid solution. A few results are included. (auth)

24524 ELECTROMAGNETIC PUMP FOR LIQUID METALS. Radchenko, R. V.; Mokrushin, S. A. (to Otdel Fiziko Tekhnicheskikh Problem Energetiki Uralskogo Filiala an SSSR. British Patent 1,299,030. 6 Dec 1972. Filed date 19 Jul 1971. 4p.

Some disadvantages of conventional electromagnetic pumps are stated and a pump is described that reduces some of these disadvantages. The pump comprises a substantially straight conduit for liquid metal, with a gapless magnetic circuit and an air-gap magnetic circuit separated by a clearance accommodating the conduit; the gapless circuit is arranged to induce in the metal an electric current at right angles to a magnetic field produced in the metal by the air-gap circuit. The current and the magnetic field interact to propel the metal along the conduit. The air-gap circuit is a multipole ac electromagnet and the gapless circuit is a polyphase transformer with as many pairs of primary and secondary windings as there are poles in the multiple electromagnet; the secondary windings are each formed partly by the liquid metal in a portion of the conduit where the current and field interact and partly by a conductor that, together with the liquid metal, envelopes the core of the transformer. The number of poles and secondary windings is preferably a multiple of the number of phases in the source energising the magnetic circuits. Due to the use of a straight conduit the hydraulic losses in the pumps are materially reduced, while its magnetic circuits impose a balanced load on the supply source. It is preferable that the gapless magnetic circuit includes a core having a row of openings equal in number to the phases, and the secondary conductors in the outer openings of the core are offset from the center of the core towards its outer walls. (UK)

24525 IMPROVEMENTS IN OR RELATING TO GAS-LUBRICATED BEARINGS. Beardmore, G.; Evans, H. N. (to Smith Industries Ltd.). British Patent 1,296,456. 6 Dec 1972. Filed date 14 Feb 1969. 8p.

Reference is made to the aerodynamic form of gas-lubricated bearings, which is finding increasing practical application in gyroscopes and other precision instruments. In this type the gas pressure results from the viscous shearing that takes place in the gas between the two bearing parts as a consequence of their relative rotation, and it is essential for the opposed surfaces to be machined to a high degree of accuracy. The effect of the viscous shearing is found in practice to be enhanced and stabilized by providing shallow spiral grooves of very accurately controlled depth and surface finish in the surface of one of the bearing parts. The opposed surfaces of the two bearings need to be hard and wear-resistant, and there is difficulty in providing the grooves. In the process described a blank of the bearing part is submitted to ionic bombardment so as to form grooves by sputtering. Very accurate control of groove depth can be obtained by regulating the sputtering time and, depending on the materials the surface finish, without any polishing. Suitable masking of the surface is required. The

process is carried out in a gaseous atmosphere (Ar) of reduced pressure. Electrons are used to establish a plasma. A magnetic field may be used to act substantially normally to the path of the electrons and to rotate relative thereto. The bearing material may be B carbide or Si carbide. (UK)

24526 COBALT-60 GAMMA IRRADIATOR FOR STERILIZATION OF MEDICAL SUPPLIES. Kasamatsu, T. (Japan Atomic Energy Research Inst., Tokai). Proc. Jap. Conf. Radioisotop.; No. 10, 465-467(Apr 1972). (In Japanese).

From Tenth conference on radioisotopes; Tokyo, Japan (16 Nov 1971).

Regarding medical equipment for sterilization by means of ^{60}Co gamma irradiation, the basic point of view and economic view are presented. It was suggested that the maximum dose be determined in accordance with the shape of targets. As an irradiator, ^{60}Co bars are placed in parallel and plate type sources are formed. The relation between distance from the source and length of the ^{60}Co source, the relation between dose rate and effective irradiation length, and the relation between mass flow rate and ^{60}Co amount were determined experimentally. From these results, important points in planning the irradiator and conditions in executing radiosterilization were suggested. Given an example of an irradiation facility, it was shown how to attain high economic efficiency. An important factor is to get cheap radioisotopes having long half-lives because cost accounting shows depreciation of ^{60}Co to be the highest. (JA)

24527 IMPROVEMENTS TO GAS CONDENSERS. Partos, A. (to Commissariat a l'Energie Atomique). French Patent 2,124,045. 22 Sep 1972. Filed date 1 Feb 1971. 16p. (In French).

A plate gas condenser type condensation device is presented. In this device, two fluids are made to circulate in separate closed spaces. The device is provided with a space in which juxtaposed stainless steel elements facilitate the circulation of the condenser gas, and a space in which alternate copper elements facilitate the circulation of the fluid coolant. Chlorine trifluoride or uranium hexafluoride can be the condensed gas. Water is used as the coolant fluid. (FR)

Heat Transfer and Fluid Flow

Refer also to abstracts 24523, and 24781–24786.

24528 (UCID-16170) PRELIMINARY MODEL FOR TRANSIENT FLOW OF COMPRESSIBLE, CONDENSABLE FLUID MIXTURES IN OPEN CONDUITS. Rozsa, R. B. (California Univ., Livermore. Lawrence Livermore Lab.). 12 Dec 1972. Contract W-7405-Eng-48. 45p. Dep. NTIS $4.25.

The flow of fluids from underground nuclear detonations is of interest because of the environmental impact of venting radioactive species into the atmosphere. A simple mathematical model is proposed for calculating the transient flow of mixtures of condensable and noncondensable fluids in open channels. Preliminary calculations that use an explicit numerical formulation are shown to predict qualitatively the behavior expected of these systems. Sample computer runs are presented for air-and-water mixtures flowing in a crack 1 m long and 0.010 in. wide. Additional modifications are discussed. (auth)

24529 HEAT TRANSFER BY NATURAL CONVECTION BETWEEN VERTICALLY ECCENTRIC SPHERES. Weber, N. (Westinghouse Hanford, Richland, WA); Powe, R. E.; Bishop, E. H.; Scanlan, J. A. J. Heat Transfer; 95: No. 1, 47-52(Feb 1973).

Natural convection to a cooled sphere from an enclosed, vertically eccentric, heated sphere is described. Water and two silicone oils were utilized in conjunction with four different combinations of sphere sizes and six eccentricities for each of these combinations. Both heat-transfer rates and temperature profiles are presented. The effect of a negative eccentricity (inner sphere below center of outer sphere) on the temperature distribution was an enhancement of the convective motion, while a positive eccentricity tended to stabilize the flow field and promote conduction rather than convection. As for concentric spheres, a multicellular flow pattern was postulated to explain the thermal field observed for the largest inner sphere utilized. In all cases the heat-transfer rates were increased by moving the inner sphere to an eccentric position, and the utilization of a conformal-mapping technique to transform the eccentric spheres to concentric spheres enabled the application of existing empirical correlations for concentric spheres to the eccentric-sphere data. It is significant to note that this technique yields a single correlation equation, in terms of only k_{eff}/k and a modified Rayleigh number, which is valid for an extremely wide range of diameter ratios, eccentricities, Rayleigh numbers, and Prandtl numbers. (auth)

24530 MIXED CONVECTION IN POROUS MEDIA. Jannot, M.; Naudin, P.; Viannay, S. (Societe Bertin et Compagnie, Plaisir, France). Int. J. Heat Mass Transfer; 16: No. 2, 395-410(Feb 1973). (In French).

A theoretical study and an experimental investigation were conducted to determine the flow interaction between free and forced convection in porous media for thermal insulation of nuclear reactors. The equations describing the model are presented and a numerical computer code was developed. The analytical results were in good agreement with the experiments. The exploitation of the code shows the governing parameters. (auth)

24531 DETERMINATION OF THE STATISTICAL CHARACTERISTICS OF TEMPERATURE FLUCTUATION IN POOL BOILING. Afgan, N.; Stefanovic, M.; Jovanovic, L. J.; Pislar, V. (Boris Kidric Inst. of Nuclear Physics, Belgrade). Int. J. Heat Mass Transfer; 16: No. 2, 249-256(Feb 1973).

The measurement of temperature fluctuation within the superheated boundary layer in pool boiling of water is presented. For the purpose of this measurement a specially developed microthermocouple probe was employed. The statistical method was used for the analysis of the temperature fluctuation. By the determination of probability density distribution and power spectral density function it was shown that the temperature fluctuation in the superheated boundary layer in pool boiling of water has statistical characteristics. From the statistical analysis of the temperature, the most probable temperature difference between water and vapor phase is determined. It is shown that the statistical characteristics of the temperature fluctuation at the vicinity of the heated wall in pool boiling of water depend on the distance from the heated wall. (auth)

24532 SOME PECULIARITIES OF HEAT TRANSFER CRISIS IN ALKALI METALS BOILING UNDER FREE CONVECTION. Kutateladze, S. S.; Moskvicheva, V. N.; Bobrovich, G. I.; Mamontova, N. N.; Avksentyuk, B. P. (Inst. of Thermophysics, Novosibirsk, USSR). Int. J. Heat Mass Transfer; 16: No. 4, 705-713 (Apr 1973).

The experiments described were carried out at low pressures from 0.01 to 2.4 bar in boiling cesium, potassium and benzene under free convection. A new mode of heat transfer crisis was found, which consists in a direct transition from a regime of usual "single-phase" heat convection to film boiling missing nucleate boiling. Critical heat fluxes in stable and unstable nucleate boiling were determined. The transition from unstable boiling to film boiling via free "single-phase" heat convection was found possible. Wall temperatures of the working section and heat fluxes were measured experimentally and boiling of metals was visualized by x-ray examination. (auth)

24533 HEAT TRANSFER AND FRICTION COEFFICIENTS FOR TURBULENT FLOW OF AIR IN SMOOTH ANNULI AT HIGH TEMPERATURES. Donne, M. D.; Meerwald, E. (Kernforschungszentrum, Karlsruhe, Ger.). Int. J. Heat Mass Transfer; 16: No. 4, 787-809(Apr 1973).

Local heat transfer and averaged friction coefficients were measured for subsonic turbulent flow of air through two smooth annuli, with diameter ratios equal to 1.99 and 1.38, respectively, having the inner tube heated to temperatures of 1000°C. The main experimental results can be summarized as follows: the local heat transfer coefficients are correlated by $Nu_B = 0.018\,(D_2/D_1)^{0.16}\,Re_B^{0.8}Pr_B^{0.4}\,(T_W/T_E)^{-0.2}$ which gives the Petukhov and Roizen correlation for low-temperature differences ($T_W/T_E \to 1$); the average heat transfer coefficients for the inner region of the annulus are correlated by $Nu_B = 0.217\,Re_B^{0.8}Pr_B^{0.4}\,(T_W/T_E)^{-0.2}$, in excellent agreement with data for circular tubes (Dalle Donne–Bowditch correlation); and the friction coefficients, both for the whole annulus and the inner region of it, were in excellent agreement with the correlations of Maubach obtained by integration of the universal velocity profile of Nikuradse, provided that density of the fluid is evaluated at the temperature $T_x = \sqrt{(T_W \cdot T_B)}$ and the kinematic viscosity at the temperature T_W, as suggested by the experiments of Taylor for circular tubes. (auth)

24534 PRESSURE GRADIENTS DUE TO FRICTION DURING THE FLOW OF EVAPORATING TWO-PHASE MIXTURES IN SMOOTH TUBES AND CHANNELS. Chisholm, D. (National Engineering Lab., East Kilbride, Eng.). Int. J. Heat Mass Transfer; 16: No. 2, 347-358(Feb 1973).

The graphical procedure of Baroozy and equations for predicting local pressure gradients during the turbulent flow of two-phase mixtures in smooth tubes are transformed for more convenient application to the case of evaporating flow. The resulting equations proved to be convenient for predicting local pressure gradients. Limited comparison is made with data for flow in channels. (auth)

Materials Testing

Refer also to abstracts 25087 and 27115.

24535 (HEDL-SA-294) PRODUCTIVITY IN NONDESTRUCTIVE TESTING: RADIOGRAPHY. Shaw, C. B. (Hanford Engineering Development Lab., Richland, Wash.). 16 Sep 1971. Contract AT(45-1)-2170. 21p. (CONF-711018-3). Dep. NTIS.

From fifty-third metals show and materials engineering congress; Detroit, Michigan, USA (18 Oct 1971).

Productivity has become a national concern. In response developmental efforts by nondestructive test equipment manufacturers provide improvements for recording x-ray images and real time (filmless) x-ray systems. NDT engineers incorporate these developments to improve product and decrease unit cost. Examples given include applications in a foundry, semiconductor manufacturer, metallurgical laboratory, and the nuclear fuels industry. (auth)

24536 EVALUATION OF THE CONCLUSIONS REACHED BY A. V. POKROVSKII AND A. G. RIPP IN THEIR ARTICLE "CHOICE OF ENERGY AND SOURCE ACTIVITY FOR A RADIOMETRIC METHOD OF ISOTOPE DEFECTOSCOPY." Valuev, N. P.; Latyshev, V. K.; Lyndin, V. V.; Mukomel, E. A. Defektoskopiya; No. 5, 135-136(1972). (In Russian).

Reference is made to a previous article by A. V. Pokrovsky and A. G. Ripp (Defektoskopiya, 1971, No. 2, p. 108) with the statement that the conclusions reached were erroneous. The method advanced for determining the energy of the source is not to be recommended for use with gamma-defectoscopes. (KSW)

24537 SELECTION OF OPTIMUM ENERGY IN GAMMA-DEFECTOSCOPY. Pokrovskii, A. V.; Ripp, A. G. (Scientific Research Inst. for Electronic Inspection, Tomsk, USSR). Defektoskopiya; No. 5, 136-140(1972). (In Russian).

The equations of N. P. Balueva et al (see previous abstract) concerning optimum energy and their discussion are refuted. (KSW)

24538 UP-TO-DATE TRENDS IN THE SOVIET INDUSTRIAL RADIOGRAPHY. Hirling, J.; Szili, S.; Fekete, Z. (All-Union Research Inst. for Radiation Techniques, Moscow). Isotoptechnika; 16: No. 2, 51-63(Feb 1973). (In Hungarian).

Novel γ-defectoscopes and methods developed at the All-Union Research Institute for Radiation Techniques, Moscow are described. (auth)

24539 DETERMINATION OF THE EXPOSURE RATE AT THE PROJECTOR WALLS OF GAMMA RADIOGRAPHY APPARATUS. Nouvet. Bull. Inform. A.T.E.N. (Ass. Tech. Energ. Nucl.), Suppl.; No. 89, 24-25(1971). (In French).

The industrial norms (NFM 60-551) defining the maximum permissible exposure rates at 5 cm and 1 m from the walls of the projector are 50 m R. h^{-1} and 10 mR. h^{-1}. The 5 cm distance was chosen because of the bulkiness of the apparatus used to measure the exposure rate. In order to ascertain that the exposure rate values at the walls do not exceed these values, an extrapolation method utilizing exposure rate measurements made at two different positions was used. (FR)

24540 EXAMPLES OF THE NONDESTRUCTIVE TESTING OF VERY THICK WELDS IN PRESSURE VESSELS. Hennion, J. (Societe Babcock-Atlantique, Saint-Nazaire, France). Soudage Tech. Connexes; 26: No. 11, 445-453(Nov 1972). (In French).

Several examples of the use of radiography in the examination of thick welds in pressure vessels are presented, i.e., use of gamma radiography to inspect a 260 mm weld and use of an 8 MeV electron accelerator in the radiography of a 415 mm weld. It is observed that radiography techniques are more sensitive to volume defects and the inclusion of slag in the bulk metal than to planar defects. A portable ultrasound testing device was developed capable of evaluating the depth of the defects. The results obtained with this equipment are presented, macrographic verifications being given. An example of the use of ultrasound in the inspection of 360 mm welds in a multilayer vessel (9 superimposed layers) is given. Particular aspects of the nondestructive testing of thick welds are discussed together with the regulations. (FR)

Nuclear Explosions

24541 (EERL-TR-E-73-1) PROJECT TRINIDAD: EXPLOSIVE EXCAVATION TESTS IN SANDSTONE AND SHALE. Redpath, B. B. (Army Engineer Waterways Experiment Station, Livermore, Calif. (USA). Explosive Excavation Research Lab.). Jul 1972. 109p. Dep. NTIS $5.45.

A series of single-, row-, and multiple-charge cratering detonations, with individual charge weights of 1 to 2 tons, were carried out in weak, interbedded sandstones and shales near Trinidad, Colorado in 1970 and 1971. The principal objectives of these excavation experiments were to obtain single-charge cratering curves, to verify row-charge designs for achieving a specified excavation, to determine the effects of millisecond delays in row-charge cratering, to experiment with cratering in varying terrain, and to compare the cratering effectiveness of several explosives. Three varieties of aluminized ammonium-nitrate blasting agents and ANFO were used. Airblast and seismic effects of each detonation were monitored. The series culminated with the excavation of a railway cut 400 ft long with 44 tons of explosives distributed among 32 charges. (auth)

24542 (FOA-4-4495-A-1) EARTHQUAKE IN HINDU KUSH, JANUARY 20, 1972. Event Report No. 2. (Hagfors Observatory, Stockholm (Sweden)). Jun 1972. 11p. Dep. NTIS (U. S. Sales Only) $3.00.

Seismic data obtained at the Hagfors Observatory in Sweden from the Jan. 20, 1972 Hindu Kush earthquake is presented. The recorded short- and long-period signals and their spectra are reported. (auth)

24543 (PNE-RB-16(Rev.1)) PROJECT RIO BLANCO DEFINITION PLAN. Volume I. Project Description. (CER Geonuclear Corp., Las Vegas, Nev.). 14 Feb 1972. 72p. Dep. NTIS $6.00.

The Rio Blanco Project for nuclear stimulation of natural gas production at the Piceance Basin, Colorado is described. Information is included on the site characteristics, experiment design, evaluation of environmental impact of the overall project, detonation activities, reentry plan, production testing, and project administration and schedule. (LCL)

24544 (PNE-RB-17(Rev.1)) PROJECT RIO BLANCO DEFINITION PLAN. Volume II. Detonation-Related Detailed Tasks. (CER Geonuclear Corp., Las Vegas, Nev.). 24 Jan 1973. 282p. Dep. NTIS $16.25.

Project Rio Blanco is the first phase of a three-phase program to demonstrate the potential of commercial development of a natural-gas field by nuclear stimulation techniques in the Piceance Basin in Rio Blanco County, Colorado. Because the gas is tightly held within the surrounding rock, this field cannot be developed by conventional stimulation methods. The first phase will consist of simultaneously detonating three nuclear explosives at different depths within the Fort Union and Mesaverde formations. The detonation of the explosives is designed to stimulate a 1,350-foot vertical section of the Fort Union and Mesaverde formations. After a 3-month waiting period, a reentry well will be drilled into the gas filled chimney, and the reservoir testing and evaluation will start. Because of the extensive detail required in planning Project Rio Blanco, the Definition Plan is presented in three volumes. The tasks needed for the operational scope of work related to the detonation such as site construction, power installation and distribution, drilling of the emplacement well, stemming plans, seismic effects documentation, and ground water protection program are discussed in Vol. II. (RCK)

24545 (SC-RR-720547) PRESSURES IN WATER ON AND NEAR AMCHITKA ISLAND, MILROW AND CANNIKIN. Merritt, M. L. (Sandia Labs., Albuquerque, N. Mex.). Feb 1973. 89p. Dep. NTIS $6.50.

Measurements of sea floor ground motion and water pressures resulting from explosions in the underlying rock were taken: in the Milrow nuclear shot, in the moderately deep water of the surrounding sea; in the Cannikin nuclear shot, in on-shore ponds and streams. Repeated reflections from the water surface and the sea floor were found to modify the pressure waves shapes from those encountered in rock. In Milrow's deep water measurements, this principally resulted in reduced peak pressures; in Cannikin's shallow water measurements, pressure waveforms closely resembled acceleration waveforms. A simple but adequate theory describing these phenomena was developed. Spall and/or cavitation in water generally result in spray and geysering in on-shore ponds and streams, and white water and spouts off-shore. Bulk or distributed cavitation was apparently present on Cannikin to a much greater extent than on Milrow. (auth)

24546 (UCID-16160) SOME COMMENTS ON PROBABILITY MODELS ASSOCIATED WITH TEST BAN CONTROL USING ON-SITE INSPECTIONS FOR EVENT VERIFICATION. Hannon, W. J. (California Univ., Livermore. Lawrence Livermore Lab.). 9 Oct 1972. Contract W-7405-eng-48. 27p. Dep. NTIS $3.50.

The probabilities associated with portions of three models of verification methods for test ban treaties using seismic criteria and on-site inspection to regulate underground nuclear explosions are considered. Although the models proposed are more refined than those published previously, the results are more sensitive to variations in parameters common to the models than

they are to the models themselves. In particular, the results are sensitive to variations in the probability that an on-site inspection will verify an actual explosion as an explosion, and to the number of explosions per time period. The uncertainties involved in the various levels of the modeling are such that it is doubtful that such treaties can be negotiated on the basis of strictly quantitative technical arguments. (auth)

24547 (UCID-16182) PERMEABILITY OF FORT UNION FORMATION SANDSTONE SAMPLES: PROJECT RIO BLANCO. Quong, R. (California Univ., Livermore. Lawrence Livermore Lab.). 3 Jan 1973. Contract W-7405-eng-48. 18p. Dep. NTIS $3.00.

The permeability of Fort Union formation sandstone samples recovered from the site of the proposed Rio Blanco nuclear gas-stimulation experiment was measured. Sample recovery depths were 5741, 5860, and 6007 ft in the RB-E-01 emplacement well. The effects of confining pressure up to 6000 psi and of water saturation up to 46% were studied in order to evaluate in situ permeability. The influence of pore or gas pressure and load-cycling history was also examined. The results indicate that permeability within a formation is highly variable and strongly influenced by both confining pressure and water saturation. Simple correlations linking permeability with physical properties, such as porosity, do not fit the observed behavior. Predictions of in situ formation permeability, based on core measurements require adequate sampling, knowledge of the interval thickness a sample represents, and a valid laboratory simulation of in situ conditions. (auth)

24548 (UCRL-51302) TRANSIENT MULTIPHASE MULTICOMPONENT FLOW IN POROUS MEDIA. Morrison, F. A. Jr. (California Univ., Livermore. Lawrence Livermore Lab.). 2 Jan 1973. Contract W-7405-Eng-48. 35p. Dep. $3.00.

One-dimensional transient two-phase, two-component flow in a porous medium was investigated analytically. The flow is described by the use of a continuity equation for each component, a momentum equation for each phase, the first law of thermodynamics, state equations, and relations for the transport properties. Local thermodynamic equilibrium was assumed. The effects of condensation and evaporation are included. The analysis shows that the flow resulting from a step change in the state at the surface of a uniform semi-infinite porous medium may be described by a single variable which is a simple function of position and time. Under other conditions, position and time must be separately specified to determine the state of the mixture. A computer program to describe the flow of an air-water mixture is presented. Results of calculations relevant to the flow of cavity gas following an underground nuclear explosion are given. (auth)

24549 (UCRL-51329) RECONNAISSANCE OF THE OIL-SHALE RESOURCES OF THE PICEANCE CREEK BASIN, COLORADO, FROM THE STANDPOINT OF IN SITU RETORTING WITHIN A NUCLEAR CHIMNEY. Borg, I. (California Univ., Livermore. Lawrence Livermore Lab). 19 Jan 1973. 14p. Dep. NTIS $3.00.

New isopach maps are presented, giving the thickness of continuous sections of oil shale averaging 15 gal/ton and 20 gal/ton in the Piceance Creek basin. They differ from maps produced heretofore in that they are based on a larger number of assayed wells and coreholes (202) and the lean or leached zones are included in the so-called "continuous sections" of a particular yield if the average of the whole section equals or exceeds the stipulated yield. Overburden maps are shown which give the depth of burial to the top of the 15-gal/ton, 20-gal/ton sections and to the top of the Mahogany marker, or A-groove if the marker was not located. These are not normalized to a "regional stream gradient" and therefore more nearly represent average overburden thicknesses in the basin. (auth)

Protective Structures and Equipment

24550 (CONF-730318-1) EXPEDIENT SHELTER TEST. Kearny, C. H.; Chester, C. V. (Oak Ridge National Lab., Tenn.). 1973. 19p. Dep. NTIS $3.00.

From Defense Nuclear Agency's mixed company/middle gust meeting; Santa Barbara, California, USA (15 Mar 1973).

The design, construction, and blast testing of two types of underground shelters which could be constructed in rural areas in two days time and of a quickly closable blast door for such shelters are described. It was concluded that: closed underground small-pole shelters could withstand about 30 psi surface overpressures from nuclear weapons in the kilton range or 20 psi surface overpressures from explosions in the megaton range; quickly closable blast doors are needed if the shelters are near the blast area; the wire-catenary-roofed underground shelters, if properly constructed in stable earth, afford good protection against blast; and the expedient shelters tested provide better blast protection than do most hasty shelters described in current military publications. (LCL)

24551 (RFP-1932) WATER SPRAY HEAT EXCHANGERS FOR HEPA PROTECTION IN ACCIDENTS (HEAT REMOVAL REQUIREMENTS AND THE EFFECT OF SMOKE AND WATER ON HEPA FILTERS). Domning, W. E. (Dow Chemical Co., Golden, Colo. Rocky Flats Div.). 1972. 24p. (CONF-720823-18). Dep. NTIS.

From 12th air cleaning conference; Oak Ridge, Tennessee, USA (28 Aug 1972).

The smoke and heat from fire occurring within a radiochemical processing facility must be vented through the buildings' high efficiency particulate air (HEPA) filtration system. This filtration system must continue to function under fire conditions, even though smoke can plug the filters and heat can damage them. Experiments were conducted to determine the design requirements of the cooling system for adequate protection of the filters. Results of the tests indicated that a water-cooled heat exchanger should be designed to handle an incoming air temperature of 1600°F from glove box exhaust, and air in the 1000 to 3000°F range from rooms. (TFD)

24552 (RFP-1997) TEST DEVELOPMENT FOR FULL-FACE-MASK RESPIRATORY EQUIPMENT. Skaats, C. D. (Dow Chemical U. S. A., Golden, Colo. Rocky Flats Div.). 14 Feb 1973. Contract AT(29-1)-1106. 10p. Dep. NTIS $3.00.

The test system for the full-face-mask respirator uses a monodisperse aerosol filter testing machine (the Q127 penetrometer) and two test heads from a Q14 gas-mask-leakage tester. The test heads utilize the entire system of the Q127 penetrometer. Dioctylphthalate (DOP) smoke from the aging chamber of the Q127 is supplied to a hand-operated nozzle for spraying mask assemblies and components. A vacuum inside the mask assembly or component under test is maintained and controlled by the Q127. The amount of smoke leaking into a defective mask is measured by the penetrometer. If more than 0.03% of smoke is detected, the mask assembly and components are repaired or rejected. (auth)

24553 UNIT FOR THE REMOVAL OF TRITIUM FROM LABORATORY ATMOSPHERES. Calf, G. E.; Smith, L. W.; Spragg, W. T. (Australian Atomic Energy Commission Research Establishment, Lucas Heights). Int. J. Appl. Radiat. Isotop.; 24: No. 3, 184-185(Mar 1973).

Contamination of the laboratory air at the Australian Atomic Energy Commission Research Establishment causes severe tritium contamination of low level aqueous environmental samples (0 to 100 TU) and despite careful drying of equipment a variable contamination of from 3 to 15 TU in "dead" water samples. A scrubbing system using Sidney tap water and a fully "open pore" ester type polyurethane foam having 97% void volume and three dimensional structure of skeletal strands as filter media is described. Results obtained over 6 months which are tabulated show that the protection is adequate except on the occasional very adverse day. (UK)

24554 FILTERS FOR AIR AND GAS PURIFICATION IN NUCLEAR INSTALLATIONS. 15 Years of Development in the Federal Republic of Germany. Hasenclever, D. (Hauptverband der Gewerblichen Berufsgenossenschaft eV, Bonn). Staub-Reinhalt. Luft; 31: No. 2, 45-51(1971). (In German).

A review of the development of high-efficiency filters used in nuclear technology for exhaust and cycle equipment is given, expecially concerning the period of the last 15 years. The treatment and safety of such equipment in practice, the test methods, the in-place tests, and particular filter equipment are discussed in detail. Unsolved or not completely solved problems are mentioned. (GF)

Safety Engineering

24555 PERSON IN CHARGE OF HANDLING RADIATION IN HIS BUSINESS LOCATION. Ichimiya, T. (Inst. of Physical and Chemical Research, Wako, Japan). Proc. Jap. Conf. Radioisotop.; No. 10, 102-104(Apr 1972). (In Japanese).

From Tenth conference on radioisotopes; Tokyo, Japan (16 Nov 1971).

In enterprises, the role played by a person in charge of handling radiation is highly significant in relation to radiation protection in general. In the Japan Radioisotope Association, the problems involved have been investigated by its ad hoc committee, i.e., by defining functions of the person in charge, an attempt will be made to improve the practice of the radiation protection. A survey and study made for the purpose are described. First, the current conceivable problems were indicated. Then, questionnaires were sent to the persons in charge actually engaged in

their work throughout Japan, concerning the problems and difficulties in their work places. On the basis of the data, peculiarities in radiation protection were studied for the groups of enterprises concerned. Measures to be taken for the improvement of situation are finally presented. (JA)

Vacuum Engineering

24556 ULTRAHIGH VACUUM APPARATUS FOR THE STUDIES OF EVAPORATION, SPUTTERING, AND SORPTION PROCESSES. Gasperic, J.; Navinsek, B. Elektroteh. Vestn.; 37: No. 9, 212-214(1970).

The design of an ultrahigh vacuum apparatus to be used for the studies of thin films, different processes occurring at cathode sputtering and production of ultrahigh vacuum is described. (Bull. Sci., Sect. A.)

24557 GROWTH OF A GaAs–GaAlAs SUPERLATTICE. Chang, L. L.; Esaki, L.; Howard, W. E.; Ludeke, R. (IBM Watson Research Center, Yorktown Heights, NY). J. Vac. Sci. Technol.; 10: No. 1, 11-16(1973).

An ultrahigh vacuum epitaxy system is described, including special features such as computer control. The system is capable of preparing sophisticated structures requiring a high degree of precise control. GaAlAs films have been grown and evaluated by various techniques; He-ion backscattering and Raman spectroscopy have been shown to be particularly valuable for periodic structures. A structure with a very narrow period has been made, and its transport properties measured and interpreted by the superlattice mechanism. (auth)

24558 DETACHABLE (111) Cu FILMS FORMED IN ULTRAHIGH VACUUM. Horng, C. T.; Vook, R. W. (Syracuse Univ., NY). J. Vac. Sci. Technol.; 10: No. 1, 160-163(1973).

Epitaxial Cu films 1200 Å thick were formed on evaporated (111) NaCl films in an ultrahigh vacuum RHEED camera. Information on the surface structure, microstructure, and surface smoothness was obtained by in situ RHEED techniques. The microstructure of the Cu films was also studied by transmission electron microscopy. (111) Cu films were doubly positioned. The smoothness of the films increased with increasing Cu deposition rate. The microstructure of the as-deposited Cu films also depended upon the deposition rate. Annealing the Cu films improved their perfection. However, the final microstructure of the annealed films was independent of the initial deposition rate. These annealed Cu layers were used as substrates for the epitaxial growth of Ag films several monolayers thick. (auth)

24559 PARTIAL PRESSURE ANALYSIS USING A TWO-CHAMBER GAUGE TOGETHER WITH AN ION–ELECTRON CONVERTER. Ertl, K.; Taglauer, E. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). J. Vac. Sci. Technol.; 10: No. 1, 204-207(1973).

A two-chamber device has been developed together with a very sensitive ion detecting system. The hot filament is placed in a separately pumped vacuum chamber, thus eliminating interaction effects of the filament with the residual gas. Electrons from the filament pass through a very small conductance orifice into the ionization chamber. The ions are detected with a tube-shaped ion–electron converter followed by a surface barrier detector. Single ion pulses can be counted and from the pulse height distributions the counting efficiency can be calculated for different ionic species. With counting losses of 3% or less for all ions, a background current of 4×10^{-21} A was measured. This leads to a minimum detectable partial pressure of about 10^{-15} torr which can be extrapolated to an ultimate sensitivity of 10^{-17} torr. The mass resolution of the magnetic analyzer is 190 (FWHM definition). (auth)

ENVIRONMENTAL AND EARTH SCIENCES

24560 (ORNL-NSF-EP-29) ORNL-NSF ENVIRONMENTAL PROGRAM PROGRESS REPORT, JUNE 30, 1972. (Oak Ridge National Lab., Tenn.). Feb 1973. Contract W-7405-eng-26. 143p. Dep. NTIS $9.25.

Topics covered include: electrical energy and its environmental impact, materials resources and recycling, regional environmental systems analyzers, environmental quality indices, environmental information system, communication, and publications. (MCG)

Minerals and Ores

24561 EXPERIMENTAL STUDY OF THE RATIO $^{234}U/^{238}U$ IN NATURAL WATERS HAVING PASSED THROUGH DIFFERENT TYPES OF ROCKS. Moreira, L.; Lalou, C. (Univ. Federal, Salvador, Brazil). An. Acad. Brasil. Cienc.; 44: No. 1, 13-18 (Mar 1972). (In French).

Alpha spectrometry measurements of the ratio $^{234}U/^{238}U$ and of uranium-238 content were made in water samples prepared by percolating through various kinds of rocks. Uranium content in the same rocks was measured by gamma spectrometry. The uranium-238 content found in water samples seems to be a function of the soluble uranium content in the rock, and for this reason, of its state of weathering. The $^{234}U/^{238}U$ ratio in the water samples after percolation is in general greater than one, which proves the greater solubility of uranium-234 in nature. A greater radioactive disequilibrium was found in water samples after percolating igneous rocks than after percolating sedimentary rocks. (auth)

24562 REPORT OF THE PRECISE SURVEY OF URANIUM DEPOSITS IN BRITISH COLUMBIA, CANADA IN 1970. Tokyo; Power Reactor and Nuclear Fuel Development Corporation (1971). 180p. (In Japanese).

The Power Reactor and Nuclear Fuel Development Corporation of Japan which has been in possession of 320 claims (about 80 Km^2) in Kelowna area, British Columbia in 1969 performed extended research for uranium deposits in the surrounding areas and other regions as well as precise survey of deposits in the above claims. These works were done by several staffs of the corporation for 180 days, from April to October in 1970 and the results are compiled in this report with a large number of maps, figures, and tables and, besides these, some appended reference papers. The survey of the Corporation's Claims was done by boring, surface observation and radiometry, and the researches in extended fields were done by car-borne radiometry, ordinary geologic survey, and collection of data from various sources. Radioactive anomalies and uraniferous beds in the corporation's claims (Fuki and Dōnen) were found mainly in Tertiary formations, and the ore beds with highest grade of 0.16% U_3O_8 were some 1.00 to 10.0 m in thickness. Extension of the deposits tended to increase with the precise survey. In other regions of British Columbia, possible uranium deposits are expected in Tertiary and Mesozoic sedimentaries or in pegmatites and some shattered zones in Paleozoic formation, but no promising mineralization was found by the researches of this time, though leaving some possibility of future discovery. (NSA of Japan)

24563 ORE-PROSPECTING. Uranium. pp 10-11 of Aarsberaettelse 1971. Stockholm; Sveriges Geologiska Undersoekning (1972). (In Swedish)

Radiometric measurements from an aeroplane were performed in the north and central portions of Sweden over a surface of about 11,000 square kilometers. A great number of anomalies were observed. About 100 of these anomalies were investigated on the ground. A few uranium deposits were discovered. (auth)

24564 ISOTOPIC COMPOSITION OF LEAD IN GALENA FROM THE MOUNTAIN PASS CARBONATITE, CALIFORNIA. Mitchell, R. H. (Univ. of Oslo). Nature (London) Phys. Sci.; 241: No. 105, 17-18(1 Jan 1973).

Isotopic composition data are presented for galena from the Mountain Pass carbonatite, California. The ore body is composed essentially of calcite and barite, with minor quantities of bastnasite and galena. The Pb isotopic ratios were determined using techniques described by Cumming (Canad. J. Phys. 49: 956(1971)), and data for $^{206}Pb/^{204}Pb$, $^{207}Pb/^{204}Pb$, and $^{208}Pb/^{204}Pb$ are tabulated. A slight degree of heterogeneity in the ore was indicated. Ages of mineral are discussed, and it was concluded that the Pb isotopic composition cannot be interpreted in terms of a single stage growth model; furthermore, model ages are anomalously large relative to the age of intrusions and tend towards the age of the country rocks. It is proposed that the Pb in the Mountain Pass galenas was derived from older lower crystal material whose Pb had evolved essentially as "main spectrum" Pb until 1650 My ago, at which time partial melting processes extracted Pb from the lower crust and resulted in the formation of the Mountain Pass galena. Some idea of the scale of the processes involved in the generation of the ore bodies can be obtained by consideration of the ^{244}Re and Ce in bastnasite. The uniqueness of the Mountain Pass carbonatite relative to other carbonatites is emphasized. (UK)

24565 RADIOGENIC LEAD IN NORTH AUSTRALIAN GALENAS. Hills, J. H. (Macquarie Univ., Sydney). Nature (London) Phys. Sci.; 241: No. 105, 18-19(1 Jan 1973).

Data are given for the $^{204}Pb/^{206}Pb$, $^{204}Pb/^{207}Pb$, and $^{204}Pb/^{208}Pb$ ratios in samples of galenas associated with the Alligator River U mineralization in Northern Australia. Some of the sample grains occurred as discriminations in the neighboring pitchblende and surrounding host rocks, others in quartz veins and stringers. In isotopic composition the galenas were similar to the Pb in the related pitchblende, but were by no means always identical. The results suggest a period of remobilization at some time, during which the galena Pb was extracted from essentially U-bearing minerals, with little or no Th, and moved to its present position with very little exposure to "common" Pb contamination, this implying any one of, or a combination of, three possible conditions: Very short distances between extraction and deposition sites; conditions that favor the breakdown of U-bearing phases to the exclusion of other minerals in the country rock, such as feldspars; and wall rocks in white Pb were virtually abreast or, alternatively, were depleted before the movement of the galena Pbs. The term "common" Pb, in this context, refers to the average composition of the Pb in the surrounding country rock when the crystals were forming. (UK)

24566 U/Pb DATING OF CHARNOCKITIC GRANITE OF AGLY (Eastern Pyrenees, France). Vitrac, A. (Univ., Paris). Compt. Rend., Ser. D; 275: No. 17, 1843-1845(23 Oct 1972). (In French).

Measurements of the concentration of U–Pb in granites were effected using isotopic dilution. The age of these granites was determined from measurements of the $^{206}Pb/^{235}U$ and the $^{207}Pb/^{238}U$ ratios. The age of the monazite was estimated to be 300 M years. (France)

24567 e-CAPTURE BY ^{40}K NUCLEI AS AN EXPLANATION OF THE EXCESS ^{40}Ar CONTENT IN SOME MINERALS. Galimov, E. M. (Inst. of Oil and Gas Industry, Moscow). Geokhimiya; No. 12, 1608-1611(Dec 1972). (In Russian).

Excess ^{40}Ar has been found in cordierite, beryls, chlorites, uraninites, and tourmalines. Accordingly, the possibility of the conversion of ^{40}K to ^{40}Ar through K-capture as a variety of β decay was explored. In minerals which contain K in the crystalline lattice, the probability of the K–Ar conversion is practically determined completely by the K-capture constant ($\lambda = 0.557 \times 10^{-10}$ years); the formation of excess Ar ensues where K exists as an impurity. (KSW)

24568 SURVEY REPORT ON THE PRESENT STATE OF URANIUM DEPOSITS IN PROVINCE OF ALBERTA, CANADA. Tokyo; Power Reactor and Nuclear Fuel Development Corporation (1971). 85p. (In Japanese).

Researches for the present state of uranium deposits, mining industry, and regulations in Province of Alberta, Canada were done by staffs of the Power Reactor and Nuclear Fuel Development Corporation of Japan in 1970, and the results are summarized. Preceding the survey report on the uranium deposits, there is a brief description of the mining regulations of the Provincial Government and introduction of main research institutes in the Province in the fields of geology and mineral deposits. Survey of the deposits was done in two regions. Dinosour Provincial Park and Cypress Hills Provincial Park. Upper Cretaceous formation, distributing in the former park, showed such low radioactivity as suggesting general absence of notable deposits. In the latter where Paleocene and Oligocene formation distributed covering the Cretaceous, the survey was possible only in some restricted spots, and general decision upon this fact may not be appropriate. However, rocks in these formations (including lignites in the Paleocene) observed in these spots were all too low in radioactivity to suggest existence of any notable deposits in this region. Besides the above regions, several claims in the same Province that have been under proposal of joint exploration with Canadian corporations were also surveyed at this opportunity, but none of them but the Simpson claim of Vestor Explorations Ltd. proved to be hopeful for Japanese investment. In the Simpson claim, some notable

mineralization of uranium was found at the basal part of the Paleozoic formation. A list of main reference prints assembled and abstracts of the quartz mining regulations and the right of entry and arbitration act of the Government are appended. (NSA of Japan)

24569 URANIUM CONTENT IN GNEISS ROCKS OF THE NORTHERN KRIVOI ROG FORMATIONS. Verbits'kii, V. M. (Inst. of Geochemistry and Mineral Physics, Kiev). Dopov. Akad. Nauk Ukr. RSR, Ser. B; No. 10, 873-875(Oct 1972). (In Ukrainian).

The uranium content in gneisses from the Northern Krivoy Rog formations depends on the regularity of the metal accumulation in the sedimentary and effusive protosubstratum. The content of the metal reflects the peculiarities characteristic of the "ideal profile" of the typical sedimentary cycle. Uranium is usually dispersed in the rocks. (auth)

Radioactive Effluents

Refer also to abstracts 26875, 26886, 26913, and 26957.

24570 (AD-748334) PILOT ECOLOGICAL FIELD SURVEY. McCormick, F.; Rosenthal, G.; Miller, D. A.; Valentino, A. R. (IIT Research Inst., Chicago, Ill.). Feb 1971. Contract N00039-70-C-1517. 32p. (IITRI-E-6159-TM-1). NTIS.

Field surveys were conducted to determine whether any local ecological changes could be detected from the low-level, nonionizing, extremely-low-frequency (ELF) radiation produced by two U. S. Navy test facilities under Project Sanguine. The surveys were conducted during 1969-70 in North Carolina and in Wisconsin. Comparisons were made with data from several types of civil facilities. (auth)

24571 (INIS-mf-277) INTEGRATION OF NUCLEAR STATIONS IN THE ENVIRONMENT. Sani, L. (Ente Nazionale per l'Energia Elettrica, Rome (Italy)). 1972. 22p. (In Italian). INIS.

The integration of nuclear stations in the environment confronts the operator with a number of problems, the main of which are discussed here with reference to the requirements of the generating system that may affect the environment, to the conditions to be met to protect the population against radiation, and more generally to the conditions to be fulfilled in order to safeguard the ecosystem. With regard to the requirements of the generating system, the need for adequate supplies of cooling water is recalled in particular. With regard to the conditions to be met to protect the population against radiation, the related problems are discussed with reference both to normal operation and emergencies. With regard to the conditions to be fulfilled to safeguard the ecosystem, the problems associated with the study of thermal effects and radioactive pollution are discussed. Finally, a list is provided of the studies and environmental investigations conducted by ENEL for environmental protection, either alone or through such organizations as CISE, the Institute of Zoology of Milan University, and the Institute of Nutrition. (auth)

24572 (ORNL-4848, pp 34-38) PROGRAM APPLICATIONS. Feb 1973.

In Environmental Sciences Division annual progress report for period ending September 30, 1972.

Progress in the Ecosystem Analysis Program is reported in the following areas of research: columnar denitrification studies; terrestrial disposal of industrial effluents; survey of ozone production association with energy production facilities; environmental effects of cooling tower drift; and IBP woodlands workshop. (HLW)

24573 (ORNL-4848, pp 49-51) APPLIED SOILS AND WASTE MANAGEMENT STUDIES. Feb 1973.

In Environmental Sciences Division annual progress report for period ending September 30, 1972.

Progress is reported on research on characterization of Pu-contaminated soil from the Nevada Test Site. The objectives are to characterize the Pu in terms of availability and fixation in various fractions of soils and to describe the potential movement of Pu both into the soil and off the soil. Studies on plugging of boreholes were conducted to develop a repository for high-level radioactive waste as well as a repository of Pu-bearing waste. A table is presented to show the permeability of plugs and the calcium content and pH of eluate from different cements curing in 20°C water for different periods of time. (HLW)

24574 NUCLEAR ENERGY AND THE LIMITATION OF ENVIRONMENTAL POLLUTION. Eklund, S. (International Atomic Energy Agency, Vienna). Izotoptechnika; 15: No. 12, 597-602 (Dec 1972). (In Hungarian).

Fission and fusion energy represent a prospective means of limiting the environmental pollution. (auth)

24575 RAPID SAND FILTERS AND RADIOACTIVITY EMERGENCIES. Craft, T. F. (Georgia Inst. of Tech., Atlanta). Bull. Ga. Acad. Sci.; 31: No. 1, 51-59(Jan 1973).

The contamination of water supplies by radioactivity is a contingency that should be included in emergency planning by water treatment plant managers. The probability of encountering this hazard is fortunately small, but the effects could be very serious and irreversible. Increasing use and transportation of radioisotopes makes their accidental release less improbable. If radioactive material is particulate or becomes absorbed on suspended matter, much of it may be removed by sedimentation and filtration, processes widely used in the purification of surface waters. The removal of dissolved radioactivity is more difficult, but the experimental data presented here show that sand and Anthrafilt filters would exert a beneficial effort. Both types of filter medium would absorb some of the radioactive matter, possibly reducing the maximum concentration in the effluent. The absorbed radioactivity would later be released to the effluent as the concentration in the influent decreased. The sorption-release pattern depends on the physical and chemical nature of the filter medium and the radioisotope involved. The presence of a radiation-detecting monitor upstream from a treatment plant intake is advisable, as it would give advance warning so that emergency measures could be started before radioactivity entered the plant. (auth)

24576 CONTROL OF FOSSIL-FUEL POWER PLANT STOCK GAS EFFLUENTS. Falkenberry, H. L. (Tennessee Valley Authority, Chattanooga); Slack, A. V.; Gartrell, F. E. Proc. Amer. Power Conf.; 34: 471-483(1972).

From 34th annual meeting of the American power conference; Chicago, Illinois, USA (18 Apr 1972).

See CONF-720465-.

The application of engineering technology to meet particulate standards is discussed. Electrostatic precipitators, preprocessing of high-ash coals, SO_2 emission reduction by wet scrubbing or dry limestone injection processes, partial coal desulfurization, and nitrogen oxides emission reduction are described. (MCG)

24577 CAT-OX PROJECT AT ILLINOIS POWER. Shultz, E. A. (Illinois Power Co., Decatur); Miller, W. E.; Barnard, R. E.; Horlacher, W. R. Proc. Amer. Power Conf.; 34: 484-490 (1972).

From 34th annual meeting of the American power conference; Chicago, Illinois, USA (18 Apr 1972).

See CONF-720465-.

The catalytic oxidation process developed to remove SO_2 from flue gas of fossil-fuel generating stations is described. Fly ash is collected, SO_2 converted to SO_3, heat is recovered to heat incoming untreated flue gas, sulfuric acid is removed, acid mist eliminated, and the acid stored. (MCG)

24578 PRACTICAL APPROACH TO NO_x REDUCTION IN UTILITY BOILERS. Seabrook, H. H. (Consolidated Edison Co., New York); Breen, B. P. Proc. Amer. Power Conf.; 34: 491-500 (1972).

From 34th annual meeting of the American Power conference; Chicago, Illinois, USA (18 Apr 1972).

See CONF-720465-.

Reduction methods are described that can be applied to large utility boilers to produce sizeable reductions in nitrogen oxide emissions without sacrificing unit output, design steam temperature, or operating efficiency. If the flame temperature is kept below 3000°F, NO_x formation is drastically reduced. The method considered best for this is called "off-stoichiometric" firing of the furnace. Recirculation of cooler flue gases back to the furnace is described as another method to reduce flame temperature. (MCG)

24579 SYSTEMS STUDY OF AIR POLLUTION FROM INDUSTRIAL BOILERS. Bernstein, R. H.; Ehrenfeld, J. R.; Parks, T. R. (Walden Research Corp., Cambridge, MA). Proc. Amer. Power Conf.; 34: 624-634(1972).

From 34th annual meeting of the American Power conference; Chicago, Illinois, USA (18 Apr 1972).

See CONF-720465-.

An inventory of boilers in terms of installed capacity was established and emissions were calculated by applying operating and emission characteristics to the boiler ratings. The cost-effectiveness of possible control approaches was analyzed. The major strategies examined included: fuel switching, flue gas treatment, and combustion modification. (MCG)

Radioactivity Monitoring and Transport

Refer also to abstract 25286.

24580 (MLM-2028) ANNUAL ENVIRONMENTAL MONITORING REPORT CALENDAR YEAR 1972. Carfagno, D. G.; Westendorf, W. H. (Mound Lab., Miamisburg, Ohio). 15 Mar 1973. Contract AT-33-1-Gen-53. 32p. Dep. NTIS $3.00.

The environment surrounding Mound Laboratory was monitored and reported on for calendar year 1972. Samples analyzed and reported on included air, water, foodstuffs, soil and silt. For radioactive species, the average concentrations of polonium-210, plutonium-238, and tritium detected were well within the standards adopted by the Atomic Energy Commission and the Environmental Protection Agency. Data concerning nonradioactive species in air and water are also presented. Data for these indicate that Mound Laboratory operations have negligible effect on the environment. (auth)

24581 (ORNL-4848) ENVIRONMENTAL SCIENCES DIVISION ANNUAL PROGRESS REPORT FOR PERIOD ENDING SEPTEMBER 30, 1972. (Oak Ridge National Lab., Tenn.). Feb 1973. Contract W-7405-eng-26. 132p. Dep. NTIS $5.45.

Separate abstracts were prepared for twelve sections of the report. Additional sections are included on education and forest management. Publications, papers, lectures, theses, and professional activities are listed. (HLW)

For abstracts of individual sections see: 24572, 24573, 24582–24587, 24615, 24622, 24937, and 27157.

24582 (ORNL-4848, pp 1-8) RADIONUCLIDE CYCLING IN TERRESTRIAL ENVIRONMENTS. Feb 1973.

In Environmental Sciences Division annual progress report for period ending September 30, 1972.

Studies on soil chemistry were conducted to determine the character of secondary reaction products and nuclide availability to plants after weathering under natural environments. Root-soil relation studies were conducted on plant uptake of ^{137}Cs, ^{106}Ru, ^{125}Sb, ^{60}Co, and ^{65}Zn from White Oak Lake soils. Other studies were conducted on radionuclide cycling in the detritus-soil-root pathway; food chain dynamics; and ecosystem dynamics. New techniques were developed for plutonium analysis of environmental samples and the use of PVP in cation saturation in x-ray diffraction studies. Comparisons were made of microbial parameters that influence nuclide transfer. (HLW)

24583 (ORNL-4848, pp 20-33) INTERNATIONAL BIOLOGICAL PROGRAM: OAK RIDGE SITE. Feb 1973.

In Environmental Sciences Division annual progress report for period ending September 30, 1972.

Progress is reported in the following areas of research: meteorological research; carbon fixation and photosynthate translocation studies using ^{14}C as a tracer; turnover of organic detritus; recycling of nutrient elements; and development of a terrestrial ecosystem model. (HLW)

24584 (ORNL-4848, pp 39-44) EASTERN DECIDUOUS FOREST BIOME, U. S. INTERNATIONAL BIOLOGICAL PROGRAM. Feb 1973.

In Environmental Sciences Division annual progress report for period ending September 30, 1972.

Progress is reported on Biome research in primary and secondary biotic production, decomposition, mineral cycling, and abiotic environmental parameters. The Biome and Regional Analysis program is concerned with the association of species and how the patterns of association change from region to region, primary productivity of entire landscape units as influenced by environmental variables, and forest succession research examining both natural and man-induced changes in the regional mixture of forest types. A mathematical model is being developed for an open-water lake ecosystem; it is designed to synthesize research results, summarize current understanding of lake ecosystems, and structure future research. The Biome Information Center is designed to provide numeric and bibliographic services for Biome investigators. (HLW)

24585 (ORNL-4848, pp 52-58) TOXIC MATERIALS IN THE ENVIRONMENT. Feb 1973.

In Environmental Sciences Division annual progress report for period ending September 30, 1972.

Research on environmental monitoring of toxic materials in ecosystems included a biogeochemical survey of trace elements in ecosystems and measurements of trace contaminants at and around the Allen Steam Plant facility. Studies on zonal configuration emphasized applied aspects in elucidating chemical and biological forms, distribution, and availability of heavy metals in the environment. Deposits of kaolin minerals were analyzed for titanium and results are tabulated. Research on plant–soil interaction included studies on uptake of ^{109}Cd from nutrient solutions. Research on toxic metals in lake and stream sediments included heavy metal behavior in mineral and sediment systems and cadmium and zinc in the Holston River and Joe Mill creek. Studies on ecology of toxic metals included the use of ^{109}Cd as a tracer for determining Cd behavior in streams, mercury transfer in an aquatic food chain, and a laboratory microcosm study of uptake, retention, and cycling of ^{203}Hg from fly ash and by stream biota. (HLW)

24586 (ORNL-4848, pp 59-70) ENVIRONMENTAL HAZARDS EVALUATION. Feb 1973.

In Environmental Sciences Division annual progress report for period ending September 30, 1972.

Progress is reported on the following research projects: development of radiation safety guides for environmental releases of radioactivity; radiological support activities for environmental impact statement preparation; characterization of the radioactivity in liquid effluents from light-water power reactors; development of computer capabilities for estimating radiation dose; radiation doses from hypothetical exposures to Rulison gas; ECOFIT: a hybrid computer program for iterative fitting of analog computer models to digital data and performing error propagation analysis; dose estimations for the hypothetical use of nuclearly stimulated natural gas in the Cherokee electric generating plant; computer techniques for estimating and controlling tritium doses from nuclearly stimulated natural gas; estimation of the contribution of radon in natural gas to natural radiation doses in homes; the relative risks from radionuclides found in nuclearly stimulated natural gas; development of sampling and analytical techniques to measure air circulation and residence times in homes; and tritium behavior in a natural gas processing plant. (HLW)

24587 (ORNL-4848, pp 79-85) APPLIED AQUATIC STUDIES. Feb 1973.

In Environmental Sciences Division annual progress report for period ending September 30, 1972.

Progress is reported on the following research projects: radionuclides in sediments of White Oak creek and White Oak lake; tritium behavior in fish from a chronically contaminated lake; long-term cytogenetic studies of Chironomus tentans; effects of radiation and temperature on the channel catfish, Ictalurus punctatus; radiation effects on aquatic communities; the niche-variation hypothesis: an experimental study with Drosophila populations; and chlorination effects on sewage effluents and natural waters. (HLW)

24588 KINETIC THEORY FOR THE ACCUMULATION OF A RADIOACTIVE SUBSTANCE IN A SOLID, APPLIED AT A VARIABLE RATE TO THE SURFACE. Bunzl, K. (Gesellschaft fuer Strahlen- und Umweltforschung mbH, Neuherberg, Ger.). Z. Phys. Chem. (Frankfurt); 81: No. 1-4, 177-188(Oct 1972).

On the basis of Eyring's model for accumulation effects, equations were derived for calculating the accumulation of a radionuclide in a solid as a function of time, depth, and the time dependent rate, at which the activity is applied to the surface layer. Diffusion effects are neglected for radionuclides showing only a very limited mobility in the solid and being accumulated only in the surface layer. They are taken into account, however, for nuclides mobile enough to penetrate into the bulk. The rate processes considered are: the time dependent rate of application of the activity to the surface, radioactive disintegration, diffusion, and irreversible absorption. This latter process is considered with regard to solids involved in ecological processes as, e.g., soil constituents. In these cases the activity of the irreversibly absorbed radionuclide is subtracted from the total activity, since it is not available to ecological processes like plant uptake or penetration into the ground water. The differential equations, which are solved by Laplace transformations, can also be used to calculate stationary state accumulations of the radionuclides after a sufficiently long time, while the activity is applied to the surface at a constant average rate. (auth)

Atmosphere

Refer also to abstract 26823.

24589 (BNWL-SA-3850) RADIOACTIVE WASTES FROM NUCLEAR POWER IN THE U.S.A. Schneider, K. J. (Battelle Pacific Northwest Labs., Richland, Wash.). 1971. 16p. (CONF-710662-1). Dep. (NTIS)

From Environmental quality conference; Washington, District of Columbia, USA (7 Jun 1971).

An overview of the radioactive waste situation from the mainline nuclear power activities is presented. The overall waste

problems from the basic fuel cycle, from mining of the fuel materials, through electrical generation in the nuclear reactor, to reprocessing and recycle of fuel, are discussed, and emission values are estimated for 1970. The most significant source of wastes is during the reprocessing of the spent nuclear fuel, where more than 99% of the significant radioactive byproduct constituents are separated into waste streams. In general, radionuclide content in gaseous and liquid effluents is held to small fractions of limits set by the Environmental Protection Agency and the International Committee on Radiation Protection. Most contaminants in gaseous wastes are reduced to low levels in effluents by processing or by holdup to permit decay of radionuclides or by dilution with large volumes or air before the gas stream is discharged to the atmosphere. Liquid wastes are generally treated to remove radionuclides before process recycle of the treated liquid or before its discharge. Residues from liquid waste treatment are generally converted to solids and buried in established state or federal repositories, as are other solid wastes. (auth)

24590 (EGG-1183-1555) RADIOLOGICAL SURVEY OF THE TATUM DOME TEST SITE AREA, MISSISSIPPI IN APRIL 1972. Technical Report No. L-1077. (EG and G, Inc., Las Vegas, Nev.). 9 Nov 1972. Contract AT(29-1)-1183. 18p. Dep. NTIS $3.00.

The Aerial Radiological Measuring System (ARMS) consists of an aircraft-borne sodium iodide gamma detector array and navigational system. It was used to perform an aerial radiological survey of the underground nuclear explosion Tatum Dome Test Site and surrounding area during April 1972. The survey data was used to map the terrestrial gamma exposure rates and collect gamma energy spectra. The terrestrial exposure rate data (gross count) are documented every other second for later computer processing into an isoexposure contour map of the survey area. The exposure rates are expressed in microroentgens per hour at the three-foot level above terrain. The spectral data are collected along each flight line for isotope identification. Results indicated the presence of isotopes normally found in the background radiation throughout the United States and at concentration levels resulting in gamma exposure rates of 2 to 6 μR/hr (referred to 3 feet above the ground level). (auth)

24591 (HASL-273) FALLOUT PROGRAM. Quarterly Summary Report, December 1, 1972–March 1, 1973. Hardy, E. P. Jr. (Health and Safety Lab. (AEC), New York). 1 Apr 1973. 227p. Dep. NTIS $3.00.

This report presents current data from the HASL Fallout Program; The Laboratory of Radiation Ecology, University of Washington; and the EURATOM Joint Nuclear Research Centre at Ispra, Italy. The initial section consists of interpretive reports on radium daughter products (^{210}Pb and ^{210}Po) and lead in marine organisms, inventories of radionuclides in the stratosphere, strontium-90 in diet, and the tropospheric baseline concentration of lead. Subsequent sections include tabulations of ^{89}Sr and ^{90}Sr levels in fallout, γ activity in surface air sampled in Central, North and South America, ^{90}Sr in the human diet, milk, and tap water in the U. S. and stratospheric inventories of ^{137}Cs, ^{238}Pu, ^{90}Sr, and ^{95}Zr up to March 1972. A bibliography of recent publications related to radionuclide studies is also presented. (CH)

24592 (HASL-273(App.)) APPENDIX TO HEALTH AND SAFETY LABORATORY FALLOUT PROGRAM. Quarterly Summary Report, December 1, 1972–Mar 1, 1973. (Health and Safety Lab. (AEC), New York). 1 Apr 1973. 451p. Dep. NTIS $3.00.

Data are tabulated on the radioactivity from fallout in environmental samples collected at selected world-wide sites and throughout the USA during the first quarter of 1973. (CH)

24593 (HEDL-SA-514) REGIONAL AIR TRANSPORT MODEL FOR RADIOLOGICAL DOSE STUDIES. Dotson, W. L. (Hanford Engineering Development Lab., Richland, Wash.). [nd]. Contract AT(45-1)-2170. 18p. (CONF-730401-2). Dep. NTIS.

From nineteenth annual technical meeting and equipment exposition of the Institute of Environmental Sciences; Anaheim, California, USA (1 Apr 1973).

A computer code, HERMES, was developed for calculations from which a reasonable estimate may be derived of the potential radiation dose and dose commitment to individuals and population groups residing in regions where nuclear power reactors, and ancillary activities such as fuel reprocessing plants and waste storage facilities, are located in the year 2000. The radionuclide air transport module, ARTRAN, of the code is described. The three types of data used include: source to receptor travel distance; effluent source rate and constituent characteristics; and meteorological variables, including wind speed and direction, atmospheric stability, mixing depth, and precipitation characteristics. (CH)

24594 (RFP-1927) PLUTONIUM RESUSPENSION FROM SOIL: HOW MEASURABLE. Michels, D. E. (Dow Chemical U.S.A., Golden, Colo. Rocky Flats Div.). [nd]. 24p. (CONF-721076-1). Dep. NTIS.

From National Industrial Hygiene Association conference; Denver, Colorado, USA (5 Oct 1972).

During a 14-month period approximately 3 millicuries of plutonium were resuspended by wind from the Rocky Flats strewnfield (120 km^2). The estimate is based on diverse data taken routinely. Of the several technical difficulties in making this estimate, the most important concern the correlations required between different kinds of measurements and the techniques used to interpret numerical data that is broadly distributed. The greatest current need relative to environmental studies concerns how the numbers can be related to concepts of public health in a valid and convincing way. (auth)

24595 (SCPRI(RM)-10-1972) REPORT OF ACTIVITY, OCTOBER 1972. Monthly Progress Report. (Service Central de Protection Contre les Rayonnements Ionisants, le Vesinet (France)). 1972. 11p. (In French). Dep. NTIS (U. S. Sales Only) $3.00.

This monthly report of the SCPRI presents the principal results concerning the surveillance of radioactivity in the environment: atmospheric dusts (air at ground level, high altitude air), rainwater, surface water, underground water, irrigation water, drinking water, food chain (milk, plants, cattle, fish), seawater around nuclear reactor sites, and other sites. The activities of various radioisotopes are presented in tables (^{7}Be, ^{95}Zr and ^{95}Nb, ^{103}Ru, ^{131}I, ^{137}Cs, ^{140}Ba and ^{140}La, ^{90}Sr, ^{106}Ru and ^{106}Rh, ^{226}Ra, ^{54}Mn, U and tritium). A bibliographic selection is included. (France)

24596 (SCPRI(RM)-10-1972(Suppl.)) DETAILS OF THE RESULTS OF MEASUREMENTS. Appendix to the Monthly Progress Report, October 1972. (Service Central de Protection Centre les Rayonnements Ionisants, le Vesinet (France)). 1972. 20p. (In French). Dep. NTIS (U. S. Sales Only) $3.25.

Measurement tables concerning the radioactivity environmental samples collected in France during October 1972 are presented. (France)

24597 (SCPRI(RM)-11-1972) REPORT OF ACTIVITIES, NOVEMBER 1972. (Service Central de Protection Contre les Rayonnements Ionisants, le Vesinet (France)). 1972. 17p. (In French). Dep. NTIS (U. S. Sales Only) $3.00.

This monthly report of the SCPRI presents the principal results concerning the surveillance of radioactivity in the environment: atmospheric dusts (air at ground level, high altitude air), rainwater, surface water, underground water, irrigation water, drinking water, food chain (milk, plants, cattle, fish), seawater around nuclear plant sites, and other sites. The activities of various radioisotopes are presented in tables (^{7}Be, ^{95}Zr and ^{95}Nb, ^{103}Ru, ^{131}I, ^{137}Cs, ^{140}Ba and ^{140}La, ^{90}Sr, ^{106}Ru and ^{106}Rh, ^{226}Ra, ^{54}Mn, U and tritium). A bibliographic selection is included. (France)

24598 (SCPRI(RM)-11-1972(Suppl.)) DETAIL OF THE RESULTS OF RADIOACTIVITY MEASUREMENT, NOVEMBER 1972. (Service Central de Protection Contre les Rayonnements Ionisants, le Vesinet (France)). 1972. 22p. (In French). Dep. NTIS (U. S. Sales Only) $3.25.

Data are presented on the levels of radioactivity in environmental samples collected from various locations in France during November 1972. (CH)

24599 (SCPRI(RM)-12-1972) REPORT OF ACTIVITY, DECEMBER 1972. (Service Central de Protection Contre les Rayonnements Ionisants, le Vesinet (France)). Dec 1972. 22p. (In French). Dep. NTIS (U.S. Sales Only) $3.25.

Data are presented on the radioactivity of environmental samples collected from various locations throughout France during December 1972. (CH)

24600 (SCPRI(RM)-12-1972(Suppl.)) DETAILS OF MEASUREMENT RESULTS. (Service Central de Protection Contre les Rayonnements Ionisants, le Vesinet (France)). Dec 1972. 31p. (In French). Dep. NTIS (U.S. Sales Only) $3.75.

Data are presented on the radioactivity of environmental samples collected from various locations throughout France during December 1972. (C.H.)

24601 (UCRL-51333) ENVIRONMENTAL LEVELS OF RADIOACTIVITY IN THE VICINITY OF THE LAWRENCE LIVERMORE LABORATORY: 1972 ANNUAL REPORT. Gudiksen, P. H.; Lindeken, C. L.; Meadows, J. W.; Hamby, K. O. (California Univ., Livermore. Lawrence Livermore Lab.). 7 Mar 1973. Contract W-7405-Eng-48. 45p. Dep. NTIS $3.00.

The Lawrence Livermore Laboratory continuously monitors the levels of radioactivity within the Livermore Valley and Site 300.

Results of analyses performed during 1972 for gross radioactivity and for specific radioisotopes of interest in a variety of environmental samples are presented in this report. In all cases, the levels of radioactivity are found to be below the concentration guide values in AEC Manual Chapter 0524. (CH)

24602 OBSERVATIONS OF RADIOACTIVITY, 1971. Helsinki; Finnish Meteorological Institute (1972). 69p. (NP-19691). $5.50.

Data are presented on the gross β activity in atmospheric samples and precipitation collected at various locations in Finland during 1971. (CH)

24603 ^{7}Be MEASUREMENTS IN GROUND LEVEL AIR AND THE AUSTAUSCH WITHIN THE LOWER PART OF THE TROPOSPHERE. Hartwig, S.; Sittkus, A. (Max-Planck-Institut fuer Kernphysik, Heidelberg). Nature (London) Phys. Sci.; 241: No. 106, 36-37(8 Jan 1973).

The concentrations of fission and spallation products in the atmosphere show a yearly variation, with a maximum in early summer and a minimum in winter; this holds for concentration measurements in precipitation and to lesser extent for measurements in ground level air. There is, however, some disagreement over measurements in ground level air and the causes of the variation. In order to endeavor to obtain information on the cause of the yearly variation, measurements were made on ^{7}Be in ground level air at two different locations at the same time, and the results are discussed. The measurements were made at Freiburg-Schauinsland (FRS) and Braunschweig (BR) over the period April 1966 to September 1968, the altitude difference being >1 km. Because of the rather large horizontal diffusion at that latitude in a comparison between the data of the two stations vertical effects should predominate. Monthly mean values of the ^{7}Be data at the two stations are shown, and amount of precipitation was taken into account; it was found that the similarity of trends in the two series of data was not related to precipitation. The mean values of the ^{7}Be activity over the entire period were 12.8 ± 3.9 atoms/g air at BR and about 25.4 ± 6.2 atoms at FRS, this significant difference proving the existence of a strong vertical concentration gradient in the lowest 1 km of the atmosphere. It also shows that the common assumption that the troposphere is well mixed, at least with regard to its lower layer, is wrong and emphasizes the necessity to take this into account in evaluations of troposphere residence times. It was also indicated that vertical turbulence is stronger in summer, tending to equalize the ^{7}Be concentration at different atmospheric levels. (UK)

Soil

24604 (RFP-1949) SCAVENGING CONTAMINATED SOIL WITH POLYURETHANE FOAM. Lindsay, J. W.; Michels, D. E.; Martinez, J. A. (Dow Chemical U.S.A., Golden, Colo. Rocky Flats Div.). 12 Feb 1973. Contract AT(29-1) 1106. 12p. Dep. NTIS $3.00.

Polyurethane foam has been evaluated as a stabilizing agent for radioactively contaminated soils. Results show that the foam can be applied efficiently to a wide variety of terrain and soils to form a lasting protective coating. In addition, the foam has a high capacity for picking up contamination, soil, and rocks, and has a relatively low cost. Its mechanical properties make handling and disposal easy. A laboratory procedure has been devised to measure quantitatively the ability of foams to pick up particulate materials by which comparisons between foams can be made. (auth)

24605 ^{137}Cs IN THE SYSTEM OF SOIL-PLANT IN THE YEARS 1964–1969. Csupka, Stefan (Oblastna Hygienicka Stanica, Bratislava). Pol'nohospodarstvo; 17: No. 5, 363-370(1971). (In Slovak).

In the course of the years 1964–1969, radiocesium in soils and lucerne was followed under natural conditions. A certain correlation was found between kalium, calcium, and phosphorus in soil and in lucerne as well as between the exchangeable kalium and radiocesium in soil. The relationship between the content of ^{137}Cs in soils and in lucern is expressed by a positive correlation (r = +0.47). There occurred a cumulation of radiocesium in soil under the influence of the fallout. The extent to which the soil component will make itself in the contamination of plants will depend especially on meteorological and soil conditions and whether radiocesium gets outside the root system of plants. (auth)

24606 ^{90}Sr CONTAMINATION OF SOME SOILS IN HUNGARY. Toeroek, I. (National Inst. for Agricultural Quality Testing, Budapest). Agrokem. Talajtan; 21: No. 3-4, 315-320 (Jul 1972). (In Hungarian).

Soil samples taken from 34 different places of Hungary have been examined. After the extraction by hydrochloride acid, the Sr was separated by the oxalate precipitation method and the activity was determined by GM scattering. The efficiency of the Sr extraction was 86%. The relative measuring error was 18%. The amount of the ^{90}Sr was 260–360 pCi/kg on pastures, and 140–240 pCi/kg on cultivated areas. According to the Sr-unit related to the Ca, the studied soils could be ranged into 4 different groups. Out of the 34 soil samples 4 had a Sr-unit below 100, that of 14 samples 100–150, that of 11 samples 150–200, and for 5 samples values higher than 200 were obtained. Extremely high values did not occur. The values measured are in accordance with data measured on other territories in Europe. (auth)

Water

24607 (BNWL-1680) RADIOLOGICAL STATUS OF THE GROUNDWATER BENEATH THE HANFORD PROJECT, JULY–DECEMBER 1971. Kipp, K. L. Jr. (Battelle Pacific Northwest Labs., Richland, Wash.). Jan 1973. Contract AT(45-1)-1830. 32p. Dep. NTIS $3.75.

An evaluation of ^{106}Ru-Rh and ^{3}H concentrations measured near the surface of the unconfined groundwater during the last half of 1971 showed that zones of detectable contamination extended in an easterly to south-easterly direction from 200-E Area (chemical processing area), as has been observed in the past. Measurable ^{3}H and NO_3^- concentrations were found along the Columbia River in the vicinity of the 100 Areas (production reactor area). A low groundwater mound showing uranium and nitrate ion continued to be observed in the 300 Area (fuel fabrication and laboratory area). A few locations for which average groundwater concentrations exceeded the Concentration Guide (CG) of 10 pCi/ml for ^{106}Ru-Rh were within either the 200-E or 200-W Areas with the exception of Well 299-E26-7 which monitors the 216-A-24 crib. During this report period concentrations of ^{106}Ru were measured independently from the total beta measurements. Significant concentrations (over 10% of CG) were found only in the 200 Areas. Total beta activity concentrations in the groundwater beneath the 100 Areas were detectable only at 100-N Area from the normal effluent discharge to the 1301 crib. (auth)

24608 (USGS-474-166) RADIOCHEMICAL MONITORING OF WATER AFTER THE CANNIKIN EVENT, AMCHITKA ISLAND, ALASKA, JULY 1972. Schroeder, L. J.; Ballance, W. C. (Geological Survey, Lakewood, Colo. (USA)). Mar 1973. Contract AT(29-2)-474. 19p. Dep. NTIS $3.00.

The U. S. Geological Survey collected water samples from Amchitka Island, Alaska, during July 1972. Tritium determinations were made on all samples collected and gross alpha and gross beta/gamma determinations were made on 41 samples. The gross alpha and gross beta determinations when compared with previously determined ranges for fresh waters on Amchitka Island showed no trends. (auth)

24609 MEASUREMENT OF THE TRITIUM CONCENTRATION OF NATURAL WATERS. Pavlicsek, I.; Veres, A.; Rakvacsne, S. O. (MTA Izotop Intezete, Budapest). Izotoptechnika; 15: No. 12, 619-25(Dec 1972). (In Hungarian).

The preparation and distillation enrichment of water samples are described. Activity measurements by means of scintillation spectrometry are discussed. (auth)

24610 OCCURRENCE OF ^{90}Sr IN THE ICE OF THE LIMNIC RESERVOIR OF THE BARRAGE. Danecka-Palasz, R.; Kwapulinski, J. Acta Geophys. Pol.; 20: No. 3-4, 335-341(1972). (In Polish).

The results of studies on the occurrence of ^{90}Sr in the limnic reservoir of the barrage are presented. The beta radioisotope concentrations found were as follows: in Kozlowa Góra 11.9 pCi ^{90}Sr, 2 pCi ^{40}K, and 12.5 pCi remaining of radioisotopes; in Goczalkowice 4.8 pCi ^{90}Sr, 2 pCi ^{40}K, and 0.6 remaining of radioisotopes. Beta radioactivity of the ice varied between 9.5 and 12.4 pCi in Goczalkowice or 28.9 and 39.0 pCi in Kozlowa Góra. It was found that the specific radioactivity of the ice and concentration ^{90}Sr in the investigated layer depends on the depth of this layer of ice. The correlation coefficient between the concentration of ^{90}Sr and depth is r = −0.9. The beta radioactivity of the higher layer of the ice is influenced by the quantity of dust. (auth)

24611 TRITIUM CONTENT OF THE NILE DELTA ZONES INDICATING THE MOVEMENT OF THE SUBSOIL WATER. Hazzaa, I. B.; Soleit, M. L.; Shata, A. A.; Mostafa, H. M.; Swellem, F. M. (Middle Eastern Regional Radioisotope Centre for the Arab Countries, Cairo). Isotope Radiat. Res.; 5: 12-17(Jun 1972).

In the middle of the Nile Delta region an area was chosen to study the vertical drainage system. As a first step to this study, the downward movement of the subsoil water was investigated. A stratigraphic hole in the locality for collection of water samples

from the successive zones was constructed. From the tritium contents of these samples the zones were identified; and the infiltration velocities were also calculated. The classified zones are given (A, B, C, D, E, and F; 0–30 m). The average infiltration velocity, ν, was calculated at ≈1.7 m/year. (auth)

24612 URANIUM CONCENTRATIONS IN MARINE SEDIMENTS. Mo, T.; Suttle, A. D.; Sackett, W. M. (Texas A and M Univ., College Station). Geochim. Cosmochim. Acta; 37: No. 1, 35-51(Jan 1973).

Uranium concentrations in a large number of marine sediment samples of different types with world-wide spatial distribution have been determined using the rapid, precise and nondestructive technique of counting the delayed neutrons emitted during ^{235}U fission induced by thermal neutrons. Several interesting relationships were apparent. (1) A direct proportionality was observed between percentage of organic carbon and uranium in sediments deposited in an anoxic environment in the Pettaquamscutt River in Rhode Island with concentrations ranging from 7% organic carbon and 7 ppM uranium to 14% organic carbon and 30 ppM uranium. A similar relationship was found in cores of sediments deposited on the Sigsbee Knolls in the Gulf of Mexico. (2) For manganese nodules a direct relationship can be seen between uranium and calcium concentrations and both decrease with increasing depth of deposition. For nodules from 4500 m in the Pacific, concentrations are 3 ppM uranium and 0.3% calcium compared with 14 ppM uranium and 1.5% calcium at 1000 m. (3) Relatively high uranium concentrations were observed in carbonates deposited in the deepest parts of the Gulf of Mexico, with the >88 μ carbonate fraction in Sigsbee Knoll cores having as much as 1.20 ppM. A model to explain the observed variations must include uranium enrichment in near shore environments via an anoxic pathway, followed by redeposition in a deep ocean environment with dilution either by low-uranium-bearing foraminiferal or silicious oozes or, along the continental margins, dilution with high-uranium-bearing carbonate sands. (auth)

Ecosystems and Food Cycles

Refer also to abstracts 25067 and 25070.

24613 (A-AC-82-G/L-1428) ANNUAL REPORT, 1971. Bruce, R. S. (ed.) (Agricultural Research Council, Wantage (England)). Letcombe Lab.). Jun 1972. 74p. Dep. NTIS (U. S. Sales Only) $5.75.

Data are presented on the content of fallout ^{137}Cs and ^{90}Sr in milk samples collected throughout the United Kingdom during 1970. Data are also included from research studies on plant nutrient uptake from soils. (CH)

24614 (NERC-LV-539-8) SELECTED CENSUS INFORMATION AROUND THE NEVADA TEST SITE. (National Environmental Research Center, Las Vegas, Nev. (USA)). Feb 1973. Contract AT(26-1)-539. 19p. Dep. NTIS $3.00.

The National Environmental Research Center-Las Vegas (NERC-LV), Environmental Protection Agency, conducts a comprehensive off-site radiological safety program in support of nuclear testing at the Nevada Test Site (NTS). To facilitate the planning and management of required surveillance and monitoring operations, and to assess potential and actual population exposures resulting from radioactive releases into the areas beyond the boundaries of the NTS, the NERC-LV collects and maintains census information in the area around the NTS. This report summarizes census information compiled in 1973, which includes the number and distribution of resident adults and children, family milk cows, and Grade A dairy cows located by azimuth and distance within a radius of 450 miles of Control Point 1 at approximately the center of the NTS, 36° 15′ N, 116° 04′ W. (auth)

24615 (ORNL-4848, pp 9-19) WALKER BRANCH WATERSHED: A STUDY OF TERRESTRIAL AND AQUATIC SYSTEM INTERACTION. Feb 1973.

In Environmental Sciences Division annual progress report for period ending September 30, 1972.

Terrestrial studies included analysis of above-ground biomass accumulation; estimation of root biomass; influence of forest type on litterfall; nitrogen and phosphorus fertilization effects on decomposition of white oak leaves; nitrogen, phosphorus, and potassium pools and fluxes in oak-hickory stands; habitat utilization and functional role of avifauna; density and biomass of canopy arthropods; and functional role of small mammal populations. Aquatic studies emphasized the sources and utilization of carbon by benthic macroinvertebrates. Laboratory and field experiments were conducted on assimilation and turnover rates of carbon in snails, mayflies, and stone flies using ^{14}C and ^{144}Ce as tracers. Hydrologic studies were carried out on flow characteristics of east and west forks and development of a computer program for input-output relationships. (HLW)

24616 (SSI-1972-2) AMOUNT OF ^{90}Sr IN DAIRY MILK 1971. Suomela, J. (National Inst. of Radiation Protection, Stockholm (Sweden)). Feb 1972. 7p. (In Swedish). INIS.

A description is given of results of measurements of the amount of ^{90}Sr in random samples of milk from dairies in different parts of Sweden. The treatment of the samples, measurement technique, and estimation of errors are described. (Sweden)

24617 (SSI-1972-8) AMOUNT OF ^{137}Cs AND ^{90}Sr IN VARIOUS FOODSTUFFS. Hagberg, N.; Suomela, J. (National Inst. of Radiation Protection, Stockholm (Sweden)). Feb 1972. 5p. (In Swedish). INIS.

A description is given of results of measurements of the amount of ^{137}Cs and ^{90}Sr in random samples of different foodstuffs included in the normal diet of Swedish people. The treatment of the samples, measurement technique, and estimation of errors are described. (Sweden)

24618 CAUSES AND EFFECTS OF CONTAMINATION OF AGRICULTURAL PRODUCTS WITH RADIONUCLIDES. Fischer, E. (Bundesforschungsanstalt fuer Lebensmittelfrischhaltung, Karlsruhe, Ger.). Ber. Landwirt.; 50: No. 2, 267-275(1972). (In German).

The contamination of food and feeds by radioactive fallout from nuclear tests has decreased to a level closely approaching that of natural radioactivity. In the future, permissible and accidental release into the environment of radioactive materials from nuclear installations might influence the radionuclide content of our foods. Problems of contamination by tritium, to which less attention was paid in the past, are discussed in this context. Continued testing of foods for radionuclides, albeit for a somewhat modified purpose, appears reasonable and necessary. (GF)

Radiometric Techniques

Refer also to abstracts 24566 and 25406.

24619 KINETICS OF ISOTOPIC EXCHANGE IN HIGHLY CALCAREOUS SOILS. Abdel-Salam, M. A.; Boulos, A. I. (Desert Inst., Cairo). Isotope Radiat. Res.; 5: 47-59(Jun 1972).

Using the clay fractions separated from Bahtim and Maryut soils, it was found that the exchangeable Ca could be satisfactorily determined by equilibration with ^{45}Ca. It was also found that most of the exchange was associated with the below one micron clay. Surface Ca in $CaCO_3$ was also found to equilibrate with ^{45}Ca and thus interferes with the exchangeable Ca determination. The relation was found to be linear, statistically significant and could be represented by regression equations. The percentage exchange (σt) was therefore calculated and the fraction exchange (F) was deduced. The relation between log (1-F) and time was plotted where two phases A and B were distinguished. The velocity constants (K) of the exchange reactions were calculated from Mackay's equation. The values of K indicated that the reactions decreased by time. The activation energy (E) of each phase was consequently obtained by substituting in Arrhenius equation. (auth)

24620 INVESTIGATIONS ON SOME ATOMIC ENERGY APPLICATIONS OF PRACTICAL INTEREST IN SOUTH-EAST ASIA, THAILAND, AND BURMA. Simon, J. (Koezponti Elelmiszeripari Kutato Intezet, Budapest); Rakoczi, L. Izotoptechnika; 15: No. 11, 576-591(Nov 1972). (In Hungarian).

The application of atomic energy for such things as: labeling of floating and rolling masses in rivers; water discharge measurements, and plant improvement by selection of radiomutants is discussed. (auth)

Site Surveys

Refer also to abstracts 24623, 26923, 26938, 26963, 26969, 26976, 26986, 26991, 26997, 27007, 27010, 27011, 27014, 27016, 27022, 27025, and 27027.

Thermal Effluents

Refer also to abstracts 24571, 24581, and 27152.

24621 (BNWL-1521) EFFECT OF THERMAL SHOCK ON VULNERABILITY TO PREDATION IN JUVENILE SALMONIDS. I. Single Shock Temperature. Coutant, C. C. (Battelle Pacific Northwest Labs., Richland, Wash.). Nov 1972. Contract(45-1)-1830. 34p. Dep. NTIS.

Thermally shocked juvenile rainbow trout and Chinook salmon were selectively preyed upon by larger fishes under controlled laboratory conditions when both shocked and control fish were offered simultaneously. Relative vulnerability to predation increased with duration of sublethal exposure to lethal temperatures. Significant increases in predation rates were found at thermal doses above 10% (Chinook) and 20% (rainbow) of the doses causing complete body inversion. The effects were partly reversible. Quantitative measures of harmful effects from sublethal thermal shock allows their use in designing safe thermal releases into aquatic environments. (auth)

24622 (ORNL-4848, pp 71-78) THERMAL EFFECTS. Feb 1973.

In Environmental Sciences Division annual progress report for period ending September 30, 1972.

Progress is reported on the following research projects: annual review of thermal effects literature; effect of cold shock on susceptibility of juvenile fishes to predation; effects of temperature and other environmental factors on the growth and development of Myriophyllum spicatum (milfoil); temperature and fish growth; effects of acute thermal shock on carp eggs; acoustic temperature telemetry from free-swimming fish; effect of temperature on rate of food consumption and phosphorus turnover in a benthic invertebrate (snail); and population dynamics of the striped bass (Morone saxatilis). (HLW)

24623 TEMPERATURE-BIOLOGICAL ASPECTS RELATED TO NUCLEAR POWER PLANT SITING, OPERATION, AND OTHER CONSIDERATIONS. Lollock, D. L. Forum (Chicago); 8: No. 2, 381-410(Win 1972).

An examination of some basic ecological concepts and selected experiments reveals that elevated temperature may be determined as a direct limiting factor to some species and communities. Although all aquatic environments are sensitive to heat, the cold-water trout and salmon fisheries are especially susceptible. The nearshore marine kelp-bed communities may be potentially as susceptible as the salmon and trout. On the other hand, it is possible to develop high value sport and commercial fisheries in selected elevated temperature areas or environments such as cooling water reservoirs. It is evident that in order to develop adequate temperature standards and criteria, the species or the communities to be protected must be designated. The desirable range must include those temperatures that will allow all other community and environmental factors to exist in favorable balance for the species designated to be protected. In considering sites for power plants, not only the thermal additions must be considered, but also entrainment of valuable resources and consumption of large amounts of high quality freshwater. Future power plant siting must be a deliberate procedure that allows time for all impacts and alternatives to be carefully examined and reviewed through the public hearing process. (ERB)

24624 PROBLEM WITH WARM WATER RELEASED FROM NUCLEAR POWER PLANTS IN THE WORLD. Kitahara, Y. (Power Reactor and Nuclear Fuel Development Corp., Tokyo). Genshiryoku Kogyo; 18: No. 9, 7-12(Sep 1972). (In Japanese).

Two environmental problems concerned with nuclear power plants are radioactivity and warm water originating in steam condensers. The world situation in the latter problem, in the United States in particular, is reviewed. The places where the warm water is released are rivers and their estuaries, lakes, and oceans including bays. Three procedures of cooling condensers, namely, closed cycle, variable cycle, and once-through systems, are explained. The Water Quality Act in the United States is described. The warm water is not necessarily harmful; it is often put to advantageous use, in a fishery, for example. The results of investigation in the United States are given. (Japan)

INSTRUMENTATION

Radiation Detection Instruments

24625 PROBE FOR RADIATION MEASUREMENT. Lamproye, M. (to Centre d'Etude de l'Energie Nucleaire). Belgian Patent 787,595. 15 Sep 1972. 20p. (In Dutch).

A radiation measuring device consisting of a radiation detector and a preamplifier is described. The device annuls the drawbacks of known types such as sensibility for shocks, limited lifetime, low sensibility for low energy β radiation and difficult repair. (BE)

24626 DIRECT TRITIUM PRODUCTION MEASUREMENT IN IRRADIATED LITHIUM. Dierckx, R. (EURATOM-CCR, Ispra, Italy). Nucl. Instrum. Methods; 107: No. 2, 397-398(1973).

A method to measure the tritium produced in lithium by neutron irradiation in fusion reactors is described. (auth)

General Detectors and Monitors

Refer also to abstracts 24811, 24820, 25073, 25406, 26071, and 26189.

24627 (BARC-628, pp 174-179) INSTRUMENTATION. 1972.

A scanning spectrometer for accurate measurements of fluorescence intensities for studies pertaining to energy migration in crystals and solutions of rare earths and actinides is described. Also, a surface barrier silicon detector for low geometry alpha counting is briefly described. (WHK)

24628 (BNWL-SA-4590) RADIOLOGICAL INSTRUMENTATION PREPAREDNESS FOR EMERGENCIES. Unruh, C. M. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab). [nd]. 57p. Dep. NTIS.

General guidelines for establishing the type of instrumentation to be used and the parameters for its use for radiation accident emergencies are discussed. Four factors are discussed in detail: need, selection, calibration, and interpretation. (WHK)

24629 (EGG-1183-2289) EFFECTS OF THICKNESS ON THE FLUORESCENCE RESPONSE FUNCTION OF NE-102 AND NE-111 SCINTILLATORS. Stevens, J.; Hocker, L. P. (EG and G, Inc., Goleta, Calif.). May 1972. Contract AT(29-1)-1183. 38p. Dep. NTIS $3.00.

The time response functions of both ^{102}Ne and ^{111}Ne were measured as a function of scintillator thickness. The thicknesses used were 0.020, 0.005, 0.0004, and 0.0002 inch. The results show a FWHM for ^{111}Ne of approximately 2.3 nsec. Within the resolution of the measurement system, no thickness dependence was observed. The FWHM for ^{102}Ne ranged from approximately 3.0 nsec for the ultrathin samples to 4.3 nsec for the 0.020-inch sample. The results also indicate that the emissions of all thicknesses of ^{111}Ne and the ultrathin samples of ^{102}Ne are relatively free of long decay-constant components. It is postulated that these results are due to the absence of a wavelength shifter in ^{111}Ne and its presence in ^{102}Ne. (auth)

24630 (LBL-1(Vol.3)(Add.1)) SURVEY OF INSTRUMENTATION FOR ENVIRONMENTAL MONITORING. Volume III. Radiation. Addition No. 1. (California Univ., Berkeley. Lawrence Berkeley Lab.). Feb 1973. 312p. Dep.

A comprehensive survey of instrumentation for environmental monitoring is being carried out by the Lawrence Berkeley Laboratory under a grant from the National Science Foundation. Instruments being investigated are those useful for measurements in Air Quality, Water Quality, Radiation, and Biomedicine related to environmental research and monitoring. Consideration is given to instruments and techniques presently in use and to those developed for other purposes but having possible applications to this work. The results of the survey are given as (a) descriptions of the physical and operating characteristics of available instruments, (b) critical comparisons among instrumentation methods, and (c) recommendations of promising methodology and development of new instrumentation. Additional sections are presented for updating of the previously published Section 3 on radiation monitoring. Topics include reactors, fuel reprocessing plants, sources of x-radiation, mining and milling of uranium ores, natural radiation backgrounds and fallout, survey meters, personnel dosimetry, and radionuclides. (WHK)

24631 (UCID-16210) REACTION HISTORY DETECTOR TIME RESPONSE MEASUREMENT. Heinle, R. A. (California Univ., Livermore. Lawrence Livermore Lab.). 7 Feb 1973. Contract W-7405-eng-48. 60p. Dep. NTIS $5.00.

Samples of all commonly used LLL weapons radiation detectors were time response calibrated on the EG&G/AEC Santa Barbara Linac. All measurements were made with 50 psec pulses at a linac energy of 12 MeV. The conditions for the measurements are described, and the data plots are presented. A standard data tape was prepared for use in folding and unfolding operations. (auth)

24632 SPARK CHAMBER RADIATION-DETECTING DEVICE. Allard, G.; Lansiart, A. (to Commissariat a l'Energie Atomique). U. S. Patent 3,717,766. 20 Feb 1973. Priority date 30 Oct 1969, France. 6p.

A device for detecting and visualizing the spatial distribution of radiation comprises three parallel electrodes disposed within an enclosure which contains an ionizable gas mixture and consisting of a grid between a cathode which is transparent to said radiation and an anode. The grid defines with the cathode a detection space in which the incident radiation causes ionization of the gas mixture and defines with the anode a space for the multiplication of electrons which are produced in the detection space and pass through the grid, thereby initiating the production of sparks. The detecting device further comprises an external circuit which provides a connection between the anode and the grid and includes means which are triggered by the sparks produced within the multiplication space in order to short-circuit said multiplication space temporarily at the time of appearance of each spark. The anode is essentially provided with two conductive coatings which are electrically connected to each other respectively on the two faces of an optically transparent support plate. One of the two coatings has high surface resistance and limits the electron multiplication space whilst the other coating has low surface resistance. (Official Gazette)

24633 SCINTILLATION CAMERA DEVICE. Tanaka, E.; Hiramoto, T.; Nohara, N.; Kurihara, S. (to National Inst. of Radiological Sciences, Science and Tech. Agency). U. S. Patent 3,717,763. 20 Feb 1973. Priority date 1 Oct 1969, Japan. 8p.

A scintillation camera device is described wherein output pulse signals from photomultipliers optically coupled with a scintillator giving forth light upon absorption of radiation emitted from a radioactive isotope taken into a foreground subject are used as an input to a delay element such as a delay line for separating said signals in time sequence in proportion to the position of each of said photomultipliers. Output signals from said delay element are shaped into single polar symmetrical wave forms in a wave forming circuit comprised of a single delay line in such a manner that the peak amplitude of the mixed wave form obtained in accordance with the position of each photomultiplier becomes proportional to the position of a scintillation point. The peak amplitude of said mixed wave forms is indicated on a cathode ray tube as a signal representing the position of the scintillation point. (Official Gazette)

24634 NUCLEAR RADIATION DETECTOR AND DEVICE FOR THE DETECTION OF LOW-ENERGY RADIATIONS. Koslov, S. F. (to Fizichesky Institut Imeni). Belgian Patent 739,202. 22 Sep 1969. Priority date 20 Sep 1968, Union of Soviet Socialist Republics (USSR).

A nuclear radiation detector is described that consists of a slab of diamond crystal on opposite sides of which are formed contacts for the purpose of application of an electric field to the crystal, the one of which on the side of the slab exposed to radiation is a blocking contact for charge carriers whereas the opposite contact, on the side of the slab that is not exposed to radiation, is made of material capable, in conjunction with the diamond, of injecting charge carriers under the effect of the applied electric field. Furthermore, the thickness of the working field of the slab is between the contacts and does not extend beyond the distance covered by the charge carriers in the diamond crystal under the effect of the applied electric field, and is characterized by the fact that the blocking contact is made of metal carbide. (BE)

24635 SENSING MATRIX FOR A RADIOACTIVITY-DISTRIBUTION DETECTOR. Grenier, R. P.; Welsh, W. F. (to Baird Atomic Inc.). U. S. Patent 3,717,762. 20 Feb 1973. Filed date 21 Sep 1970. 6p.

In a radioactivity-distribution detector, an array of light conduits in spaced relation to a plurality of visible light emitters (scintillators) defining a grid network is provided for identifying and specifying the location of an active or light generating emitter. The conduits are disposed in a plurality of row pairs, the first of the pair being in bisecting staggered spaced relation

to the second of the pair. Specific ones of the light emitters are in exclusive spatial relationship with selected ones of the light conduits and other ones of the light emitters are in spatial relationship with a specified combination of light conduits, whereby each emitter is identified by either a single light conduit or a unique combination of light conduits. (Official Gazette)

24636 PHOTOMULTIPLIER TESTING DEVICE. Bhattacharya, P. K. (High Altitude Research Lab., Gulmarg, India). Def. Sci. J. (New Delhi); 22: No. 1, 43-48(1972).

The design of a photomultiplier testing device constructed to assess long-term stability and suitability of 53 AVP photomultipliers for use with singles counting, scintillation counter arrays, and large plastic scintillation counter arrays (in coincidence) in high-energy physics experiments (with muons) is reported. The device can be used for routine checking of such phototubes in the laboratory. (Indian Science Abstracts)

24637 FORMATION AND RELEASE OF ELECTROMAGNETIC PULSES IN NUCLEAR RADIATION DETECTORS WITH AVALANCHE FORMATION. Michel, H. S. (Staatliche Zentrale fuer Strahlenschutz, Berlin). Isotopenpraxis; 8: No. 7, 244-248(Jul 1972). (In German).

After the incidence of an ionizing particle, nuclear radiation detectors sometimes release high electromagnetic pulses in the radiofrequency range. The fundamental data of this process are shown and field calculations are performed with a model to be compared with measurement results. Possibilities of practical application are indicated. (auth)

24638 NEUTRON SPECTROMETRY IN ZERO-POWER FAST SYSTEMS, IN PARTICULAR USING THE PROTON RECOIL PROPORTIONAL COUNTER. Albert, D. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Kernenergie; 15: No. 10, 337-340(Oct 1972). (In German).

Proton recoil spectrometer techniques are discussed, and a comparison with other experimental techniques and the use of measured results to improve nuclear data are mentioned. (auth)

24639 CONTROLLABLE SECONDARY ELECTRON EMISSION AND SOME POSSIBILITIES OF ITS UTILIZATION IN PARTICLE DETECTORS. Lorikyan, M. P.; Kavalov, R. L.; Trofimchuk, N. N.; Serov, V. L. (Inst. of Physics, Erevan). Izv. Akad. Nauk Arm. SSR, Ser. Fiz.; 7: No. 2, 118-121(1972). (In Russian).

Transmission secondary electron emission from KCl low-density films at high electric fields was studied. (auth)

24640 e-(x,A) COINCIDENCE METHOD FOR THE ACCURATE DETERMINATION OF INTERNAL CONVERSION COEFFICIENTS. Hansen, H. H.; Spernol, A. (EURATOM, Geel, Belg.). pp 695-700 of Radioactivity in Nuclear Spectroscopy. Vol. II. Hamilton, J. H. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From International Conference on Radioactivity in Nuclear Spectroscopy; Nashville, Tennessee, United States of America (USA) (11 Aug 1969). See CONF-690818-(Vol. 2).

The principle of the method is outlined, and the choice of detectors and performance of measurements and corrections are briefly discussed. (WHK)

24641 ENERGY AND INTENSITY STANDARDIZATION OF Ge(Li) SYSTEMS WITH ^{110m}Ag GAMMA RAYS. Hamilton, J. H.; Brahmavar, S. M. (Vanderbilt Univ., Nashville). pp 1323-1328 of Radioactivity in Nuclear Spectroscopy. Vol. II. Hamilton, J. H. (ed.). New York; Gordon and Breach Publishers, Inc. (1972).

From International Conference on Radioactivity in Nuclear Spectroscopy; Nashville, Tennessee, United States of America (USA) (11 Aug 1969). See CONF-690818-(Vol. 2).

24642 USE OF A HARDWARE MULTIPARAMETER ANALYZER IN RADIOACTIVITY AND NUCLEAR REACTION COINCIDENCE MEASUREMENTS. Pages, A.; Avril, M.; Moreau, R.; (and others) (CEN, Saclay, France). pp 1423-1427 of Radioactivity in Nuclear Spectroscopy. Vol. II. Hamilton, J. H. (ed). New York; Gordon and Breach Publishers, Inc. (1972).

From International Conference on Radioactivity in Nuclear Spectroscopy; Nashville, Tennessee, United States of America (USA) (11 Aug 1969). See CONF-690818-(Vol. 2).

24643 COMPUTER PLOTTED CONTOUR LINE MAPS USED FOR GRAPHICAL TREATMENT OF COINCIDENCE MEASUREMENTS. Kamoun, R.; Veyrie-Faucon, A. (CEN, Saclay, France). pp 1429-1433 of Radioactivity in Nuclear Spectroscopy. Vol. II. Hamilton, J. H. (ed.). New York; Gordon and Breach Publishers, Inc. (1972).

From International Conference on Radioactivity in Nuclear Spectroscopy; Nashville, Tennessee, United States of America (USA) (11 Aug 1969). See CONF-690818-(Vol. 2).

24644 FURTHER EVALUATIONS OF CdTe AS A GAMMA-RAY DETECTOR. Palms, J. M. (Emory Univ., Atlanta); Edwards, D. M.; Wood, R. E.; (and others). pp 1449-1453 of Radioactivity in Nuclear Spectroscopy. Vol. II. Hamilton, J. H. (ed.). New York; Gordon and Breach Publishers, Inc. (1972).

From International Conference on Radioactivity in Nuclear Spectroscopy; Nashville, Tennessee, United States of America (USA) (11 Aug 1969). See CONF-690818-(Vol. 2).

24645 USE OF FLEXIBLE PLASTIC TUBES FOR AUTOMATIC RECORDING OF PARTICLE TRACKS. Conversi, M. (Univ., Rome). Nature (London) Phys. Sci.; 241: No. 113, 160-161(26 Feb 1973).

Flexible plastic tubes, with a mixture of inert gases flowing through them, can form the basic elements of a new type of "electrically pulsed chamber" potentially useful for the automatic recording of charged particle tracks. The instruments are sensitized by a large electric pulse applied immediately after the occurrence of the physical event to be studied. Under these conditions a luminous discharge occurs in those tubes through which ionizing particles have passed, but not in the other tubes if they are protected from external light. Photon emission and secondary ionization processes ensure that the discharge propagates along the whole length of the tube, but the discharge is interrupted at the grounded metal boxes that connect each tube element to the next one. Information corresponding to the "flashing" can be extracted from the elements by two different methods; firstly by means of a probe in contact with the plasma formed in the flashing tube, or secondly by a monofilament optical fibre that collects from the flashing tube an optical signal of sufficient intensity to be recorded by a vidicon-type system. Many elements are of course needed to give a large collecting area, and an arrangement is described suitable for installation over one of the experimental straight sections of the Adone electron-positron Frascati storage ring. Some tests are described with a ^{106}Ru source and a counter-coincidence system. (UK)

24646 SILICON SURFACE BARRIER DETECTORS FOR MONITORING NEUTRON FLUX DISTRIBUTION IN PRESSURIZED WATER REACTORS. Glasow, P.; Spillekothen, H. G. (Siemens AG., Erlangen, Ger.). Siemens Forsch. Entwicklungsber.; 1: No. 3, 287-291(1972).

The power distribution within the reactor core of a PWR, e.g., the Stade Reactor is monitored by scanning activation ball columns using ^{51}V as the indicator isotope. The γ-spectra are simultaneously determined by a large number of thin silicon surface barrier detectors. The suitability of these detectors for the counting of γ-quanta is studied, especially their reliability at high irradiation doses in the reactor. (GF)

24647 SEMICONDUCTOR RADIATION DETECTORS. Part I. Kuhn, L. (Siemens AG, Erlangen, Ger.). Messtechnik; 80: No. 11, 313-321(Nov 1972). (In German).

The recent status of theory and characteristics of semiconductor radiation detectors are described. Several quantities measured and conversion equations for the energy resolution of semiconductors are given. The charge sensitive amplifier is described. (auth)

24648 INFLUENCE OF SELF ABSORPTION ON THE EFFICIENCY OF GEL SCINTILLATORS COMPARED WITH ^{35}S-ACTIVATED ALKALINE EARTH SULPHATES. Hofmann, H.; Roedel, W. (Univ., Heidelberg). Int. J. Appl. Radiat. Isotop.; 24: No. 1, 47-49(Jan 1973). (In German).

The influence of self absorption on the efficiency of response of gel scintillators to alkaline earth ^{35}S was studied using $CaSO_4$ and $BaSO_4$. The effects of particle size on the response of $BaSO_4$ and of light yield on $CaSO_4$ was investigated. The efficiency of $CaSO_4$ scintillators with 0.06 mm grain size was 77.6 ± 0.8%; $BaSO_4$ with grain sizes of 0.06 mm to 0.2 mm varied from 56.4 ± 0.6% to 39.1 ± 0.4% (0.1–0.2 mm grain size). The efficiency of $CaSO_4$ was practically constant for changes in light yield of up to 13%. (UK)

24649 CONTEMPORARY STATE OF DEVELOPMENT OF Cd–Te DETECTORS. Skrivankova, M. (Inst. of Nuclear Research, Rez, Czech.). Jad. Energ.; 19: No. 2, 47-50(Feb 1973). (In Czech).

A brief survey on the development and features of CdTe detectors is presented. The advantages of CdTe vs other types of semiconductor detectors are described. Some problems presenting the achievement of good results in γ-spectroscopy, e.g., gross imperfections and, most important, the influence of traps in available materials are discussed. On the other hand, a possible application of CdTe as a simple detector is considered. Temperature effects and special demands on electronics to be used with the detectors are also mentioned. (auth)

24650 NATURE OF THE AMPLITUDE SPECTRUM OF A NUCLEAR PARTICLE DETECTOR. Lomashevich, S. A.; Strokan, N. B.; Tisnek, N. I. (Ioffe Inst. of Physics and Tech., Leningrad). Sov. Phys.-Semicond. (Engl. Transl.); 6: No. 7, 1118-1121(Jan 1973).

Translated from Fiz. Tekh. Poluprov.; 6: No. 7, 1278-1282 (Jul 1972).

The influence of fluctuations of noise, ionization, and charge collection on the response function $C_0(q)$ of a semiconductor detector must be allowed for in sequence. It is shown that the amplitude spectrum is of probabilistic nature. An equation is derived for truncating the spectrum with suitable allowance for the finite sensitivity of the amplitude analyzer. The universal properties of the function $C_0(q)$ are used to obtain an expression which is applicable to the spectra of detectors of different quality. A method of plotting the function $C_0(q)$ for various charge losses is demonstrated. (auth)

24651 AIR SAMPLING AND INSTRUMENTATION. pp 96-101 of Inhalation Risks from Radioactive Contaminants. Vienna; International Atomic Energy Agency (1973).

See STI/DOC—10/142.

The practical problems and requirements of the design of air sampling instruments are reviewed, and the possibility of measuring the parameter (AMAD) which characterizes the deposition pattern of the aerosol in the respiratory tract is examined. Topics include devices based on inertial collection, samplers depending on precipitation, fiber and membrane filters, mines, and external counting for plutonium. (WHK)

24652 ACQUISITON AND REDUCTION OF MULTIPARAMETER DATA WITH FIXED PROGRAM DEVICES. Ramayya, A. V. (Vanderbilt Univ., Nashville). pp 235-263 of Radioactivity in Nuclear Spectroscopy. Vol. I. Hamilton, J. H. (Ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From International Conference on Radioactivity in Nuclear Spectroscopy; Nashville, Tennessee, United States of America (USA) (11 Aug 1969). See CONF-690818-(Vol. 1).

With the fabrication of high resolution solid state detectors, there has been increased need for highly sophisticated data acquisition and control systems, especially in coincidence spectroscopy. This demand resulted in development of large fixed program multiparameter analyzers (FPMA) and computer controlled systems. Large FPMA systems were already successfully employed for two parameter coincidence experiments at various laboratories. The operational ease in setting up the coincidence experiments, usefulness and limitations of such a system are examined. The examination covers the three distinct aspects of the hard-wired analyzer systems: 1. data acquisition, 2. data handling and display, 3. data reduction. The potentialities of coincidence experiments employing solid state detectors and multiparameter analyzers are illustrated with several examples of experiments performed in this laboratory and elsewhere. A computer program for sorting the related addresses stored on a magnetic tape in a coincidence experiment is in preparation. Utilization of this program in FPMA systems will facilitate the analysis of directional correlation experiments. (auth)

24653 MEASUREMENT OF TOTAL PARTICLE ENERGY IN A LARGE SOLID ANGLE DETECTOR. Fredrickson, D.; Carroll, J.; Goitein, M.; Kline, R.; MacDonald, B.; Perez-Mendez, V.; Stetz, A. (Univ. of California, Berkeley). Nucl. Instrum. Methods; 107: No. 2, 205-207(1973).

A large-area, thick plastic scintillation counter (60 cm × 60 cm × 10.65 cm) has been used to measure the energy of stopping ^{3}He nuclei. Energy resolution of the counter was 6% fwhm, independent of measured energy. The gain of the counter was electronically stabilized. Average pulse heights for monoenergetic particles varied 10% over the face of the counter, but we were able to correct for this non-uniformity to within 1% using position information from spark chambers. The effects of nuclear breakup on the pulse height distribution have been studied in detail. (auth)

24654 CALCULATED PHOTOPEAK EFFICIENCIES OF NaI (Tl) SCINTILLATION DETECTORS WITH SELF-ABSORPTION IN THE SOURCE. Rieppo, R. (Univ. of Oulu, Finland). Nucl. Instrum. Methods; 107: No. 2, 209-212(1973).

Photopeak efficiency values have been calculated for NaI-detectors measuring 2″ × 2″ and 3″ × 3″. The dimensions of extended cylindrical sources were considered as well as self-absorption in the source material. (auth)

24655 TIMING RESOLUTION WITH THIN SCINTILLATORS. Calligaris, F.; Cernigoi, C.; Ciuti, P.; Giacomich, R. (Univ., Trieste, Italy). Nucl. Instrum. Methods; 107: No. 2, 213-219 (1973).

The timing properties of plastic scintillators and photomultipliers are investigated in view of the more recent technology and electronics available at present. The intrinsic limits of the techniques are discussed. (auth)

24656 EFFI: A MONTE CARLO PROGRAM FOR CALCULATING THE EFFICIENCY OF AN ORGANIC SCINTILLATOR NEUTRON DETECTOR. Hermsdorf, D.; Pasieka, K.; Seeliger, D. (Technische Univ., Dresden). Nucl. Instrum. Methods; 107: No. 2, 259-268(1973). (In German).

The Monte-Carlo program EFFI, simulates the detection process of neutrons within a cylindrical organic scintillator for incident neutron energies up to 15 MeV. The calculation of detection efficiency for the liquid scintillator NE 213 at the detection threshold of 0.81 MeV shows the important role of the $^{12}C(n,\alpha)^9Be$ and $^{12}C(n,n')3\alpha$ reactions above 9 MeV neutron energy. The contribution of multiple neutron scattering of the detection efficiency is also investigated in detail. Approximative calculations in the framework of analytical expressions for the efficiency are compared with EFFI's results to draw conclusions about applicability of these expressions and their limitations. (auth)

24657 FAST NEUTRON POLARIMETER WITH CARBON ANALYZER AND PULSE-SHAPE DISCRIMINATION. Sherwood, J. E.; McDaniel, F. D.; McEllistrem, M. T. (Univ. of Kentucky, Lexington). Nucl. Instrum. Methods; 107: No. 2, 317-320(1973).

A description is given of a fast neutron polarimeter. The instrument has been used with a carbon analyzer to study the ^9Be $(p,\vec{n})$ reaction with proton energies from 4.8 to 6.4 MeV. Spurious and undesired events are rejected by a combination of pulse shape, pulse height, and time-of-flight discrimination. The results are comparable with those obtained with a helium analyzer. (auth)

24658 PROMPT TIMING RESPONSE IN X-RAY, HEAVY ION EXPERIMENTS USING NaI(Tl) AND SURFACE-BARRIER DETECTORS. Lerche, R. A.; Wehring, B. W.; Wyman, M. E. (Univ. of Illinois, Urbana). Nucl. Instrum. Methods; 107: No. 2, 321-327(1973).

The results of an investigation of timing with a delayed coincidence system containing a NaI(Tl) scintillator and a silicon surface-barrier detector are presented. A model for the system is described and an analytical expression for the prompt response is developed. The analytical expression is compared with the prompt response measured for the alpha decay of ^{252}Cf and the subsequent ^{248}Cm L x-ray emission. The comparison indicates that the model adequately describes the timing response of the system. Also, an analytical expression is presented which represents the timing spectrum produced by the radioactive decay of several nuclear species folded with the system prompt response. The use of this expression to analyze complex timing spectra is demonstrated by unfolding measured timing data that represent the time intervals between fission and the emission of K x-rays. (auth)

24659 SILICON RUBBER SCINTILLATION COMPOUND FOR COMPLEX GEOMETRY RADIATION DETECTORS. Bussini, A.; Dean, A. J.; DiRaffaele, R.; Gerardi, G.; Igiuni, A. (Laboratorio di Fisica Cosmica e Tecnologie Relative, Milan). Nucl. Instrum. Methods; 107: No. 2, 333-335(1973).

A scintillation compound, consisting of Ne-224 scintillator and silicon rubber, which cures at room temperature, is described. The scintillation efficiency and optical transmission for different concentrations are discussed. (auth)

24660 LARGE VOLUME, HIGH EFFICIENCY SCINTILLATION DETECTORS USING MULTIPLE NaI(Tl) CRYSTAL PIECES. Fishman, G. J. (Teledyne Brown Engineering, Huntsville, AL); Walker, D. M. Nucl. Instrum. Methods; 107: No. 2, 357-360 (1973).

A method of constructing large volume, high efficiency scintillation detectors by immersing NaI(Tl) crystals in an optical coupling fluid is described. A large annulus has been constructed by this method and will be used in a low-level counting system. The resolution of the annulus is 45% at 661 keV, and its efficiency is approximately 50% at 1 MeV. (auth)

24661 POSSIBLE SOLUTION TO THE RIGHT-LEFT AMBIGUITY IN DRIFT CHAMBERS. Charpak, G.; Sauli, F. (CERN, Geneva). Nucl. Instrum. Methods; 107: No. 2, 371-373(1973).

A method is proposed to solve the right–left ambiguity in drift multiwire proportional chambers by looking at the positive induced pulses on adjacent couples of wires. (auth)

24662 TIMING FILTER AMPLIFIER. Karlsson, L. (Royal Veterinary and Agricultural Univ., Copenhagen). Nucl. Instrum. Methods; 107: No. 2, 375-380(1973).

A filter amplifier for use in timing experiments involving semiconductor detectors is presented. The gain of the amplifier can be varied continuously from 2 to 200. One integrator section and two differentiator sections allow for appropriate pulse shaping

to be performed. The upper −3 dB bandwidth of the amplifier is 50 MHz, and is independent of the gain setting used. (auth)

24663 TELESCOPE FOR SOFT GAMMA RAY ASTRONOMY. Schoenfelder, V.; Hirner, A.; Schneider, K. (Max Planck-Institut fuer Physik und Astrophysik, Munich). Nucl. Instrum. Methods; 107: No. 2, 385-394(1973).

A gamma ray telescope using the double Compton process is described which measures extraterrestrial gamma ray fluxes in the energy range 1 to 10 MeV. The detector consists of two large plastic scintillator blocks, 1.20 m apart. A gamma ray event is identified by a Compton collision in the upper detector, followed by a second scattering in the lower crystal, the sequence being verified by a time of flight measurement. The properties of the telescope were measured in the laboratory using the gamma ray sources ^{60}Co and ^{24}Na. The telescope has an opening half angle of 15° (hwhm) with an energy resolution of ±20% and an absolute detection efficiency of about 0.5%. Also, it has an especially low sensitivity to undesired background gamma rays. A slightly modified version of the telescope will be used in balloon flights to measure the spectrum of diffuse primary gamma rays. (auth)

24664 DIFFERENTIAL COUNTER FOR THE DETERMINATION OF SMALL DIFFERENCES IN DECAY RATES. Harbottle, G.; Koehler, C.; Withnell, R. (Brookhaven National Lab., Upton, NY). Rev. Sci. Instrum.; 44: No. 1, 55-59(Jan 1973).

A proportional detector system for the determination of small changes in the rate of decay of a radioisotope has been constructed. It operates on the principle of differential comparison of the unknown decay rate with that of a known, usually practically nondecaying (e.g., ^{36}Cl) reference. The apparatus can be used both for the determination of long half-lives and for studying the effect of chemical state upon the half-life of a radioisotope. (auth)

24665 RADIATION STABILITY OF PLASTIC SCINTILLATORS. Beregovenko, E. D.; Gorbachev, V. M.; Uvarov, N. A. At. Energ. (USSR); 34: No. 2, 124(Feb 1973). (In Russian).

Changes in the light output of polystyrene while under the influence of pulsed x-rays were evaluated. The transparency of polystyrene from 1 to 10 min after pulsed irradiation was measured during exposure to gamma quanta from ^{60}Co. Ten minutes after irradiation the transparency of the scintillator was restored by a factor of 400. (KSW)

24666 PROPERTIES OF SILICON CARBIDE DETECTORS FABRICATED BY BERYLLIUM DIFFUSION. Tikhomirova, V. A.; Fedoseeva, O. P.; Kholuyanov, G. F. At. Energ. (USSR); 34: No. 2, 122-124(Feb 1973). (In Russian).

The detecting properties of hexagonal single crystals of SiC with W−Ni alloy as the ohmic contacts to the n-side were investigated using α-particles and ^{235}U fission fragments. The SiC detectors were prepared by the diffusion of Be at about 1650°C for 20 to 30 min, the coefficient of diffusion of Be being from two to three times higher than B or Al. A comparative study of the radiation stability of SiC detectors showed that the stability is slightly dependent on the nature of the acceptor. Use of the SiC detectors at high temperatures for the measurement of the neutron fluxes in fuel elements was possible. (KSW)

24667 EFFICIENCY OF SILICON SEMICONDUCTOR DETECTORS FOR GAMMA QUANTA OF 0.661 AND 1.25 MeV ENERGIES. Gol'din, M. L.; Pater-Razumovskii, K. R.; Virnik, F. V. At. Energ. (USSR); 34: No. 2, 121-122(Feb 1973). (In Russian).

In the use of Si for radioisotope instruments where gamma quanta of 0.661 and 1.25 MeV are commonly encountered, the Compton interaction predominates. Formulas for p-i-n detector efficiency are employed to calculate the linear coefficient of relaxation as a function of the ratio of the energy of the primary γ-quantum to the threshold of recording. The results were experimentally tested by recording γ-quanta with type DKD-0 and DDR 12/2 detectors. (KSW)

24668 DIGITAL RECORDING OF RADIOMETRIC MEASUREMENTS. Bavin, V. P.; Volodin, K. M.; Eremin, A. A.; Lintser, A. A. At. Energ. (USSR); 34: No. 2, 127-128(Feb 1973). (In Russian).

An automatic recording system for radiometric measurements was designed for geological prospecting and uranium mine studies, and was required to be portable with a self-contained power pack. Digital output was designed to be continuous or discrete, depending upon the application in bore-hole logging. Punched tape and magnetic tape operation are described. (KSW)

24669 ^{108m}Ag AS A CALIBRATING SOURCE FOR THE ABSOLUTE EFFICIENCY OF Ge(Li) DETECTORS. Das Mahapatra, B. K.; Mukherjee, P. (Saha Inst. of Nuclear Physics, Calcutta). Nucl. Instrum. Methods; 107: No. 3, 611-612(1973).

From the analysis of the sum peaks in the decay of ^{108m}Ag (127 y) observed with a Ge(Li) detector the absolute photopeak efficiencies of the gamma rays have been determined. The isotope is suggested as a calibrating source for the absolute efficiency of Ge(Li) detectors in the region 100 keV to 1 MeV. (auth)

24670 DETECTION OF LOW ENERGY COSMIC X RAYS. Francey, R. J.; Baird, G. A.; Green, D. W.; Wilson, B. G.; Woollam, W. H. (Simon Fraser Univ., Burnaby, B. C.). Nucl. Instrum. Methods; 107: No. 3, 589-595(1973).

An experiment designed to measure the soft (≈280 eV) cosmic x-ray flux is described. The proportional counter used in the experiment was pressure regulated during a 800 s flight by the vapor pressure from a liquid reservoir. It is shown that it is possible to control the detection efficiency by varying the temperature of the liquid reservoir. The effect of such changes are illustrated for one particular model of the diffuse x-ray background. Details of the first flight package and preliminary performance data are presented. (auth)

24671 PHOTOFRACTIONS FROM EXPERIMENTAL RELATIVE PHOTOPEAK EFFICIENCIES OF A 3″ × 3″ CsI(Tl) CRYSTAL. Irfan, M.; Prasad, R. D. G. (Memorial Univ. of Newfoundland, St. John's). Nucl. Instrum. Methods; 107: No. 3, 583-588 (1973).

Relative photopeak efficiencies of a 3 in. × 3 in. CsI(Tl) crystal have been experimentally measured in terms of the corresponding photopeak efficiencies of a 3 in. × 3 in. NaI(Tl) crystal in the energy range 0.279 to 3.25 MeV and for crystal-to-source distances of 3.0 cm and 10.0 cm. Absolute detection effficiencies of the 3 in. × 3 in. CsI(Tl) crystal have been calculated by using the "scaling relations" and the values of this quantity for a 3 in. × 3 in. NaI(Tl) crystal available in literature. Photofractions of the 3 in. × 3 in. CsI(Tl) crystal have been evaluated by using the above mentioned quantities and Heath's (AEC R and D report IDO-16880) values of photofractions of a 3 in. × 3 in. NaI(Tl) crystal. These evaluated photofractions have been compared with the theoretical values given by Miller and Snow (AEC Report ANL-6318). The discussion includes some other comparisons, also. (auth)

24672 ETCHING OF POLYCARBONATE CHARGED PARTICLE DETECTORS BY AQUEOUS SODIUM HYDROXIDE. Paretzke, H. G. (Institut fuer Strahlenschutz, Neuherberg, Ger.); Gruhn, T. A.; Benton, E. V. Nucl. Instrum. Methods; 107: No. 3, 597-600(1973).

The chemical composition of the reaction products of polycarbonate film and aqueous NaOH has been studied. This system is widely used for the development of charged particle tracks. The principal organic component of the aqueous phase is the anion of Bisphenol A. When large amounts of plastic have been decomposed the anion of phenol may become a major species. A method employing ultra-violet absorbance is suggested for monitoring the concentration of the etch products in the solution. The composition of an etching solution becomes more complicated with increasing age as a result of air oxidation. A remarkable difference between the polycarbonate types Lexan and Makrofol KG has been found since the bulk etching rate of Makrofol KG is independent of etch product concentration. Studies of this type are aimed towards a more fundamental understanding of the bulk and track etching processes. (auth)

24673 INCREASING THE IMAGE CONTRAST OF PLASTIC DETECTORS WITH FLUORESCENT STAIN. Fink, D. (Hahn-Meitner Institut fuer Kernforschung, Berlin). Nucl. Instrum. Methods; 107: No. 3, 615-616(1973). (In German).

Plastic detectors were etched and rubbed in with fine grain fluorescent powder. Under dark field illumination with ultraviolet light, the irradiated zones showed up brightly with good contrast to unirradiated areas. (auth)

24674 MONTE CARLO CALCULATION OF CLAD NaI(Tl) SCINTILLATION CRYSTAL RESPONSE TO GAMMA PHOTONS. Steyn, J. J. (NUS Corp., Rockville, MD); Huang, R.; Harris, D. W. Nucl. Instrum. Methods; 107: No. 3, 465-475(1973).

Pulse height response distributions, photofractions and efficiencies for clad and photomultiplier mounted NaI(Tl) crystals were determined using the Monte Carlo method. Results for right-cylindrical crystals exposed to point source and parallel beam incident photons are presented as a function of energy up to 4.45 MeV. The data consider the effects of collimation and cladding thickness. The results are in excellent agreement with published Monte Carlo data for bare crystals and experimental data for clad crystals. (auth)

24675 METHOD TO DETERMINE THE γ-RAY ATTENUATION COEFFICIENTS. Gopal, S.; Sanjeevaiah, B. (Univ. of Mysore, India). Nucl. Instrum. Methods; 107: No. 2, 221-225(1973).

The percentage resolution of the scintillation spectrometer is studied by interposing carbon, aluminum, copper, tin, and lead

absorbers of different thicknesses t between the source and the detector. For these thickness γ-ray attenuation coefficients μ are measured using the counting sequence of Conner et al. (Phys. Rev. A1, p. 539). The results show that the percentage resolutions and attenuation coefficients remain fairly constant for values of $\mu t < 1$. This implies that the number of multiple scattered photons reaching the detector becomes negligible and the narrow-beam-collimated geometry condition is preserved when the thickness of the sample satisfies the above criterion. The present investigations indicate that the counting sequence adopted by Conner et al. together with the criterion $\mu t < 1$, would greatly improve the measured γ-ray attenuation coefficients. (auth)

Radiation Dosimeters

Refer also to abstract 24936.

24676 (BARC-642) STATISTICAL EVALUATION OF THE PRECISION OF A CaF_2 TLD SYSTEM. Rao, P. S.; Govindarajan, K. N.; Nambi, K. S. V.; Sachidharan, R. (Bhabha Atomic Research Centre, Bombay (India)). 1972. 14p. Dep. NTIS (U. S. Sales Only) $3.00.

A group of 10 CaF_2 TL dosimeters was repeatedly (38 times) exposed to an integral gamma dose of 164 mR using a Panoramic Exposure Assembly having a precision of ±0.2%; the dosimeters were read immediately after each exposure. The data collected were processed using the theory of analysis of variance and the precision of the TLD system consisting of both the dosimeter and the reader was estimated to be about ±5%. The different factors affecting the accuracy of the measurements are also discussed. (auth)

24677 (BNWL-1616) SECOND AEC WORKSHOP ON PERSONNEL NEUTRON DOSIMETRY, JULY 8-9, 1971, New York, New York. (Battelle Pacific Northwest Labs., Richland, Wash). 1971. Contract AT(45-1)-1830. 109p. (CONF-710714-). Dep. NTIS.

From 2nd workshop on personnel neutron dosimetry; New York, New York, USA (8 Jul 1971).

Research and development activities are reported from ORNL, LLL Livermore, Chalk River Nuclear Labs, BNL Battelle-Northwest, Rocky Flats, Savannah River Plant, University of Wisconsin, and Stanford Linear Accelerator. Ten papers were presented. Topics include albedo neutron dosimeters, anthracene dosimeters, fission fragment dosimeters, thermoluminescent dosimeters, and thermally stimulated exoelectron emission dosimeters. Also, the results of a survey of procedures and equipment for spark counting of fission fragment dosimeters at several laboratories are tabulated. (WHK)

24678 (IFA-PN-26) DOSIMETRY OF HEAVY PARTICLE RADIATION ($Z \geq 2$) WITH NUCLEAR EMULSIONS AND SOLID TRACK DETECTORS. Haseganu, D.; Nicolae, M. (Institutul de Fizica Atomica, Bucharest (Romania)). 1972. 12p. (In French). Dep. NTIS (U. S. Sales Only).

A method for the dosimetry of heavy particle radiation was developed using nuclear emulsions and cellulose nitrate track detectors. In order to decrease the fading of the latent image during long exposures, the use of a high-sensitivity emulsion, associated with a discriminatory development method, is proposed. The discrimination development method is described. This method for the dosimetry of heavy particle radiation, which permits the ion spectra to be divided into ionization groups, covers a very wide interval of the energy spectrum of the ions present in primary cosmic radiation. The nuclear emulsion method with the discriminatory development is superior to the cellulose nitrate method. This method can detect relativistic particles beyond Z = 12, even in group III, whereas the relativistic threshold of the nitrate is at Z = 26. The method also avoids the background of relativistic protons. (JSR)

24679 (ORNL-4850) STUDY OF CORRELATED THERMALLY ACTIVATED POLARIZATION, CONDUCTION, AND LUMINESCENCE EFFECTS IN LITHIUM FLUORIDE AS FUNCTIONS OF IRRADIATION, DOPING, AND THERMAL HISTORY. Fields, D. E.; Moran, P. R. (Oak Ridge National Lab., Tenn.; Wisconsin Univ., Madison. Dept. of Physics). Mar 1973. Contract W-7405-eng-26. 87p. Dep. NTIS $3.00.

Thesis. Submitted by D. E. Fields to Univ. of Wisconsin, Madison.

Three related phases of investigations of electrical and luminescence phenomena in pure and doped lithium fluoride are described. First, the simple trapped carrier-free carrier recombination model often used to describe thermoluminescence (TL) and thermally activated conductivity (TAC) experiments is considered. Both TL and TAC curve shapes depend sensitively on parameter values in the model and general separate solutions for them have not been derived. Arguments are presented that the actual system possesses significant spatial correlation between trapped carriers and optically active recombination centers. Next, a study is made of thermally activated polarization (TAP) and thermally activated depolarization (TAD) effects resulting from impurity-vacancy dipole reorientation in Mg doped and undoped lithium fluoride in the temperature region 200 to 250°K. These results are compared to earlier measurements of a radiation-induced thermally activated depolarization (RITAD) effect in the same samples. Reorientation rate activation parameters of activation energy $E_a = 0.44 \pm 0.03$ eV and preexponential factor $W_0 = 10^{8.5\pm1.5}$ sec^{-1} were measured for simple divalent impurity-vacancy dipole reorientation in samples annealed at high temperatures and quenched. Development of a second polarization phenomena having $E_a = 0.86 \pm 0.03$ eV and $W_0 = 10^{13\pm1.5}$ sec^{-1} is observed after annealing several days at room temperature and is apparently due to the formation of stable dipole complexes in which dipole-dipole interactions lead to the replacement of E_a and W_0 by temperature-dependent functions. This second feature is observed at a peak temperature only 2.7% higher than the peak temperature of the 0.44-eV feature, 220°K. Finally, initial observations of a new radiation-induced phenomenon in LiF are reported; a large permanent electrical polarization can be induced in LiF by ionizing radiation. Specific radiation-induced polarizations, after thermal depolarization, can be regenerated optically but not by thermal repolarization. Rate parameters characterizing thermal depolarization differ from those of other thermally activated processes. This effect has a signal-to-noise ratio comparable to simultaneous thermoluminescence measurements, which suggests many practical possibilities. (auth)

24680 THERMOLUMINESCENCE AT LOW IRRADIATION DOSES. De Garay y Arellano, A. Mexico City; Univ. Nacional Autonoma de Mexico (1972). 53p. (In Spanish).

Thesis.

The dosimetric behavior of CaF_2: Mn, LiF, and $CaSO_4$: Dy was studied. A revision is first made of the mathematical model based on the Schoen equations, which explain the phenomenon of thermoluminescence. The thermoluminescent response of the three dosimeters was determined experimentally. The thermal equilibrium of CaF_2: Mn in the presence of a ^{60}Co source was determined; and the thermoluminescent spectra of CaF_2: Mn and $CaSO_4$: Dy were determined as a function of the source-dosimeter arrangement in the irradiation device. The thermoluminescent response of CaF_2: Mn crystals and $CaSO_4$: Dy discs for mixed β and γ radiation was determined. The action of absorbers placed between the ^{90}Sr source and CaF_2: Mn crystals and $CaSO_4$: Dy discs was determined. Self-absorption in $CaSO_4$: Dy was studied using discs of the same material and a ^{90}Sr source. The response of the dosimeter with variation of the radius of a collimator placed between a disc of $CaSO_4$: Dy and an approximately point source of ^{90}Sr was determined. The results are shown graphically and discussed. (JSR)

24681 INSTRUMENTAL CONTROL OF STERILIZING DOSES WITH THE AID OF ALCOHOI -CHLOROBENZENE DOSIMETERS. Horvath, Z.; Foldiak, G. (MTA Izotop Inteset, Budapest). Izotoptechnika; 15: No. 10, 531-537(Oct 1972). (In Hungarian).

The determination of the dose rate distribution around an 80 kCi ^{60}Co source is carried out by means of an alcohol-chlorobenzene dosimeter. A method for the homogenization of the absorbed doses is described. (auth)

24682 IONIZING RADIATION DOSIMETRY THROUGH MEASUREMENT OF EXOELECTRON EMISSION. Mueller, F.; Stolz, W. (Technische Univ., Dresden). Isotopenpraxis; 8: No. 5, 161-167(May 1972). (In German).

The use of exoelectron emission for dosimetry is discussed. In comparison with thermoluminescence, exoelectron dosimeters are more sensitive, have a larger linear range, are lighter and less expensive, the gamma energy can be modified easily by addition of substances such as graphite; they can be used at higher temperatures; they are suitable for detection of low-energy electrons and soft x rays; and they are also applicable in the dosimetry of fast neutrons. At the present time, exoelectron dosimetry is not sufficiently advanced for practical applications. Further systematic studies must focus on fading, re-use, effect of impurities, radiation temperature, and thermal pretreatment. (88 references). (HBG)

24683 LATENT SUB-IMAGES IN PHOTOGRAPHIC FILMS EXPOSED TO ^{60}Co GAMMA RAYS. Callaby, D. R. (Italia Research Labs., Ferrania). J. Photogr. Sci.; 20: No. 5, 157-166(1972).

Measurements were made of the amount of sub-image grains present in photographic films after exposure to γ-rays from a cobalt-60 source. It was found that the ratio of grains with sub-images to those with a full latent image was low when the mean grain size of the emulsion was more than 0.5 μ in diameter but

rose rapidly to values above unity for emulsions having mean grain sizes less than 0.4 μ. The results showed that on average the electrons produced by the μ-rays must travel at least 0.3 μ within a grain of the emulsion to produce a latent image. It also follows that grains of diameter less than 0.3 μ need to interact with more than one high-energy electron to produce a latent image. (auth)

24684 EFFECT OF TRAY CURRENT ON THE SENSITIVITY OF CON RAD 5100 THERMOLUMINESCENCE DOSIMETRY READERS. Harvey, J. R.; Tobias, A.; Townsend, S. (Berkeley Nuclear Labs., Eng.). Health Phys.; 24: No. 4, 437-438(Apr 1973).

Following a complaint that the sensitivity of a particular Con Rad 5100 reader could have either of two values differing by 9% due to magnetization of the dynodes in the photomultiplier tube by current passing through the heater tray, the sensitivity variations in four Con Rad 5100s have been examined. In no case was there a significant trend in the mean value of sensitivity during the course of 100 readings and the bulk of the sensitivity values lay within ±2% of the mean. There was no evidence of two groups of sensitivity values and it is suggested that this effect is not common. (UK)

24685 CHANNEL ELECTRON MULTIPLIER AS DETECTOR OF THERMALLY STIMULATED ELECTRONS. Onsgaard, J.; Hougs, E. (Univ. of Odense, Denmark). Int. J. Appl. Radiat. Isotop.; 24: No. 1, 55-57(Jan 1973).

The use of a channel electron detector in a TSEE measuring system is reported. Spectra of LiF and NaCl have been recorded. A schematic diagram of the experimental set-up is shown. It is stated that in relation to the conventional electron multiplier the channel electron detector offers flexibility. The power requirements and dimensions are smaller and it can withstand exposure to atmosphere during sample changing. (UK)

24686 PHOTOGRAPHIC DOSIMETERS. Soudain, G. (CEN, Fontenay-aux-Roses, France). Secur. Med. Trav.; No. 21, 105-110(May 1972). (In French).

Photographic dosimeters are the only instruments legally accepted for the dosimetry of working personnel. Classifications of the radiations to which workers may be exposed are given. Only electrons and photons having energies between 10 keV and 3 MeV and neutrons having energies of less than 0.6 eV or between 0.6 eV and 14 MeV are considered. The effect of radiation on a photographic emulsion was studied. Blackening dosimeters must be accompanied by nuclear emulsion results in the case of neutrons having energies greater than 0.6 eV. Several different sensitivity emulsions are necessary to cover the equivalent dose region of interest in health physics. The PS1 type dosimeter used by the CEA consists of a screen-holder casing containing a Kodak–Pathe Type 1 photographic film and possibly a Type A Eastman–Kodak N.T.A. nuclear emulsion. This type of emulsion is described. A radiothermoluminescent glass (dosimeter) or a radiophotoluminescent glass can be incorporated into this type of dosimeter. Routine utilization using Kodak–Pathe film (Type 1) and N.T.A. type emulsion is discussed. (FR)

24687 CRITERIA FOR FILM BADGE PERFORMANCE. ANSI N13.7 1972. New York; American National Standards Institute (1972). 15p.

A testing procedure and performance criteria are prescribed for film badges exposed to beta particles, neutrons, and photons. (MOW)

24688 EVALUATION OF THE SENSITIVITY OF PERSONAL DOSIMETERS BASED ON TYPE "K" NUCLEAR EMULSION TO DOSES OF THERMAL, INTERMEDIATE, AND FAST NEUTRONS. Gelev, M. G.; Komochkov, M. M.; Mishev, I. T.; Salatskaya, M. I. At. Energy. (USSR); 34: No. 2, 118-121(Feb 1973). (In Russian).

The sensitivity of dosimeters for individual control using Type "K" nuclear emulsion was calculated as functions of the neutron energy with and without phantoms. The sensitivity of the dosimeters was measured at various installations including a synchrocyclotron, a synchrophasotron, and a cyclotron facility. The sensitivity of Type "K" emulsion to thermal neutrons at E < 0.4 eV, 0.4 to 0.5 MeV, and 0.5 to 1.5 MeV (Po–Be source) was 1.6, 0.16, and 0.92 (all $\times 10^{-4}$ track/cm^2·barn), respectively. (KSW)

24689 USE OF THE T.I.G. FILM BADGE DISOMETER AROUND THE UA-RR-1 REACTOR. Abdel-Razek, M.; Gomaa, M. A. (Atomic Energy Establishment, Cairo). Isotope Radiat. Res.; 5: 1-4(Jun 1972).

The TIG-film badge characteristics were studied at the UA-RR-1 reactor for γ rays, thermal neutron, and intermediate neutron dose estimates, through the interaction of the mixed field of radiation with the badge filters. The minimum detectable doses were found to be 10 m rem for γ rays, 1 m rem for thermal neutrons, and 20 m rems for intermediate neutrons when the film badge was worn by the radiation worker. (auth)

Nuclear Spectroscopic Instrumentation

Refer also to abstracts 24821, 26173, 26232, 26255, 26276, and 26316.

24690 (AECL–4217) GAMAN: A COMPUTER PROGRAM FOR THE QUALITATIVE AND QUANTITATIVE EVALUATION OF Ge(Li) γ-RAY SPECTRA. Felawka, L. T.; Molnar, J. G.; Chen, J. D.; Boase, D. G. (Atomic Energy of Canada Ltd., Pinawa (Manitoba). Whiteshell Nuclear Research Establishment). Jan 1973. 103p. Dep. NTIS (U. S. Sales Only) $7.25.

A computer program coded in Fortran IV is described for the evaluation of complex γ-ray spectra obtained with Ge(Li) detectors. It is suitable for use with a computer having 16K of core memory. The spectral data, recorded on magnetic tape, are initially smoothed, and the significant photopeaks detected by observing changes in the sign of the first derivative of a quadratic polynomial smoothing function. A modified Gaussian function is fitted to each photopeak, and the peak area and position determined. Calibration data obtained from standard radioisotope sources allow the intensity of each peak in a spectrum to be calculated and the energy to be determined to within ±1 keV. By comparison of the energies with nuclear data held in a library of radioisotopes, each component isotope of the spectrum is identified, and its disintegration rate calculated. The program is able to analyze spectra containing up to 50 isotopes, and can, in principle, resolve groups of up to seven overlapping peaks. Examples of the application of the method to complex spectra are given, and its advantages and further development are discussed. A complete program listing and a users' guide are included as appendices. (auth)

24691 (AECL-4369) CORRELATIONS BETWEEN CRYSTAL AND SPECTROMETER PROPERTIES OF A LARGE GERMANIUM CRYSTAL. McMath, T. A.; Ungrin, R. A. (Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs). Jan 1973. 21p. Dep. NTIS (U. S. Sales Only) $3.25.

A number of experiments were performed in an effort to correlate properties of a large germanium crystal with the spectrometer properties of Ge(Li) detectors made from the crystal. Measurements of the spatial variation of etch pit density, lithium drift mobility, lithium precipitation rate, and spectrometer resolution, pulse height, and relative peak counting efficiency are reported. (auth)

24692 (CONF-720404–(Vol.1), pp 709-718) DETECTION OF LOW ENERGY ELECTRONS WITH A CHANNELTRON IN A MAGNETIC β-SPECTROMETER. Hansen, H. H.; Mouchel, D.; Mutterer, M. (EURATOM, Geel, Belgium). Jan 1973.

From International conference on inner shell ionization phenomena and future applications; Atlanta, Georgia, USA (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

The detection of low energy electrons (E < 30 keV) with conventional detectors is, in general, considerably limited by relatively high cut-off energies. This restriction can be overcome with suitable windowless channel electron multipliers. Such a channeltron has been used as electron detector in a magnetic β-spectrometer. The detection efficiency of the device has been determined for electron energies E > 0.05 keV using an electron gun and a radioactive ^{241}Am source of known decay rate. (auth)

24693 (CONF-721010-56) METHOD FOR SYSTEMATICALLY ANALYZING Ge(Li) PHOTOPEAKS. Steyn, J. J.; Reier, M. (NUS Corp., Rockville, MD; Jet Propulsion Lab., Pasadena, Calif.). 1972. 9p.

From International conference on modern trends in activation analysis; Saclay, France (2 Oct 1972).

A relatively straightforward method of fitting Ge(Li) photopeaks with a Gaussian histogram is presented. The method, which is especially suited to photopeaks which are distributed over a relatively small number of channels, determines photopeak area, pulse height, resolution and the residual background. Results are given to indicate the Gaussian distribution of the experimental data from −1 σ to +6 σ. (FR)

24694 (DP-Report-640) GAIN STABILIZED SEMICONDUCTOR COMPTON SPECTROMETER. DRAGON PROJECT. Bartlett, A. C.; Reed, D. L. (Atomic Energy Establishment, Winfrith (England)). May 1969. 36p. Dep. NTIS (U. S. Sales Only) $4.00.

A semiconductor gamma spectrometer system is presented in which gamma rays scattered out of the primary detector by Compton events are registered in a NaI crystal and give rise to a coincidence pulse which gates the input to the multichannel analyzer. A

simple single interaction model for calculating the efficiency of such a spectrometer is suggested. A comparison of the efficiency computed from the model and from the experimental measurements is made and shows that within the precision of the model the agreement achieved is adequate. The short term gain stability of the spectrometer using a spectrum stabilizer and reference gamma source is investigated. (auth)

24695 (KFK-1707) CAMAC FINE ATTENUATOR LEM-52/11.1 AND CAMAC FINE ATTENUATOR LEM-52/11.2. Fischer, P. M.; Froehlich, D. (Kernforschungszentrum, Karlsruhe (West Germany). Labor fuer Elektronik und Messtechnik). Dec 1972. 19p. (In German). Dep. NTIS (U. S. Sales Only) $3.00.

Two computer-controlled fine attenuators according to CAMAC specifications with very sensitive controller settings are described. Such a unit is used in the field of nuclear spectroscopic measurements where very exact gain adjustment of a linear amplifier must be achieved. With the fine attenuator LEM-52/11.1 the attenuation ratio is maximum 1:0.99; with the fine attenuator LEM-52/11.2 the attenuation ratio is maximum 1:0.91. In each case the range of the attenuation is subdivided into 2000 steps. The gain attenuation adjustment is controlled by a stepping motor driving a 10-turn servo potentiometer. The most important electrical characteristics of the two fine attenuators are: Input polarity: unipolar or bipolar; input voltage amplitude: 0 to 10 V; output voltage range: ±10 V; bandwidth: 0 to 50 Mhz; output offset voltage: 20 mV (25°C up to 75°C). (auth)

24696 (KURRI-TR-108) HIGH SPEED TIME ANALYZER WITH WIRE MEMORY. Kimura, I. (Kyoto Univ. (Japan). Research Reactor Inst.). 1972. 25p. (In Japanese). Dep. NTIS (U. S. Sales Only).

A 1024 channel high-speed time analyzer was made by using a plated wire as a memory element. This time analyzer has two operation modes, TOF mode (add-one mode) and MS mode (multi-scaler or add-N mode), both of which use a 133 MHz crystal oscillator. Channel width of the former mode can be selected from 15 ns to 3.84 μs (9 stages) and that of the latter from 1 μs to 65.536 ms (9 stages). For background counting, the last eight channels have longer channel widths and selective delays. These channel width and delay times were tested with random pulses from a liquid scintillation counter and a weak radioactive source and periodic pulses from a pulser. The results agreed with the designed values satisfactorily. Dead time for the TOF mode was found to be about 270 ns and that for the MS mode was about 19 ns in counting and about 250 ns in memory cycle. These values are drastically shorter than previous time analyzers, such as TMC-211. This time analyzer has been applied to fast neutron time-of-flight experiment with an electron linear accelerator and pulsed neutron experiment in beryllium oxide piles. In this case, no correction for count loss by dead time of a time analyzer is required. (auth)

24697 (LBL-1568) OPERATIONAL CHARACTERISTICS OF GERMANIUM DETECTORS AT HIGHER TEMPERATURES. Pehl, R. H.; Haller, E. E.; Cordi, R. C. (California Univ., Berkeley. Lawrence Berkeley Lab.). Dec 1972. Contract W-7405-eng-48. 19p. (CONF-721202-16). Dep. NTIS.

From Nuclear science symposium; Miami Beach, Florida, USA (6 Dec 1972).

Several important areas for the use of germanium spectrometers would be opened if these detectors could be successfully operated at temperatures considerably in excess of 77°K. Precise measurements on a series of detectors made from different high-purity germanium crystals and on one lithium drifted germanium detector indicate that the resolution does not degrade significantly until nearly 150°K is reached. Similar-sized detectors, including the lithium-drifted device, exhibited essentially identical temperature-resolution relationships. (auth)

24698 (RT/EL-(72)6) SEMICONDUCTOR DETECTORS SOFT X-RAY SPECTROMETRY: STATE OF THE ART AND FUTURE PERSPECTIVES. Colante, D. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 30 May 1972. 40p. (In Italian). Dep. NTIS (U. S. Sales Only) $4.00.

The limits of detection in the field of soft x-ray lithium-drifted silicon detectors are discussed. A review of the current situation is given, with special focus on the detector-preamplifier system. The sensitivity, asymptotically attainable with the present techniques, could be overcome by the development of semiconducting detectors providing an internal gain through a mechanism of carrier multiplication. (auth)

24699 (UCRL-Trans-10678) LOW-NOISE CHARGE-SENSITIVE PREAMPLIFIER FOR SURFACE-BARRIER DETECTORS FOR ENERGY ANALYSIS OF LIGHT IONS. Schmidl, H. (Max-Planck Institut fuer Plasmaphysik, Garching (West Germany)). Translation of IPP-9/3. Dec 1971. 35p. Dep. NTIS $3.75.

A preamplifier which, because of its solid construction as a printed circuit, is easy to reproduce and is also suitable for laboratory use, but which has very good noise characteristics and a low detection limit, is described. With it, 6 keV protons with a half-value width of 1.5 keV were satisfactorily detected. (auth)

24700 DEVICE FOR NON-DESTRUCTIVE CONSUMPTION TESTING OF REACTOR FUEL ELEMENTS. Hiller, S. (to Siemens Aktiengesellschaft). U. S. Patent 3,717,765. 20 Feb 1973. Priority date 4 Apr 1970, Federal Republic of Germany (F. R. Germany). 6p.

Apparatus for the nondestructive consumption testing of nuclear fuel elements in a basin includes inserting at least one gamma-ray collimator through the wall of the basin and having one end thereof connected to a gamma spectrometer. The other end of the collimator is coupled to a water evacuated tube connected with the guide structure of the fuel element being tested. The fuel element is vertically moved past the collimator so that the consumption state of the element can be tested. (Official Gazette)

24701 AUTOMATIC ANALYSIS OF GAMMA-RAY SPECTRA ON SMALL COMPUTERS. Achterberg, E.; Iglesias, F. C.; Jech, A. E.; Moragues, J. A.; Perez, M.; Rossi, J. J.; Scheuer, W.; Suarez, J. F. (Comision Nacional de Energia Atomica, Buenos Aires). IEEE (Inst. Elec. Electron. Eng.), Trans. Nucl. Sci.; NS-19: No. 5, 3-9(Oct 1972).

A program for the automatic analysis of Ge(Li) gamma-ray spectra is described. Owing to its reduced size it can be used on small (16 K memory words) computers. For the design of the program, the steps of manual methods of analysis have been followed as closely as possible. Most of the subroutines are written in Fortran II language. (auth)

24702 PHOTONUCLEAR AND NEUTRON REACTIONS AVAILABLE AS ACTIVATION DETECTORS UNDER HIGH GAMMA-RAY-FLUX FIELD. Nakamura, R.; Hirayama, H. (Kyoto Univ.). Nippon Genshiryoku Gakkaishi; 14: No. 12, 668-677(1972). (In Japanese).

In the spectrum measurement of bremsstrahlung radiation and photoneutrons generated from targets in the accelerator, it is difficult to detect them with pulse-type detectors, since a large γ-ray burst is produced. In such high γ-ray-flux fields, activation detectors are an effective means for spectra measurements of γ-rays and neutrons. For this, the two spectra must be obtained without mutual interaction. To this end, information on photonuclear reactions and their cross section data can serve as γ-ray detectors under a neutron coexisting field, and information on neutron reactions and their cross section data can serve as neutron detectors in a high γ-ray-flux field. A combination of several reactions makes it possible to measure the energy spectra of photons in the energy range of about 5 to 30 MeV and of neutrons above about 1 MeV. (auth)

24703 FABRICATION OF Si(Li) DETECTORS FOR A 4π BETA SPECTROMETER. Farzine, K.; Schmitz, B. (Ruhr Univ., Bochum, Ger.). Kerntechnik; 15: No. 1, 27-30(Jan 1973). (In German and English).

A fabrication method is described for planar Si(Li) diodes that are used in a $4\pi\ \beta$ spectrometer. The detectors have a diameter of 18 mm and are 4 mm thick. The diode holder with its thin front contact corresponds to the requirements of a $4\pi\ \beta$ spectrometer. The energy resolution, plotted as a function of the distance between source and detector, is 2,3 keV at a distance of 3 mm. A part of a ^{207}Bi spectrum recorded under the best measurement conditions is shown. (auth)

24704 PROFILE OF NUCLEAR SPECTROSCOPIC STUDIES OF RADIOACTIVE NUCLEI AS SEEN FROM INSTRUMENTATION. Hayashi, T. (Kyoto Univ.). Nippon Genshiryoku Gakkaishi; 14: No. 11, 600-608(Nov 1972). (In Japanese).

The present status of nuclear spectroscopy with the use of radionuclides as seen from the side of instrumentation and experimental methods is reviewed. It is remarked that the current status of progress in nuclear instrumentation is mainly due to improvements seen in the precision and rapidity of measurements. The impact brought upon γ-ray spectroscopy by the introduction of Ge detectors with its marked precision is described in connection with the resulting revelation of the complexity of the nuclear decay scheme. Mention is made of the tendency toward the use of multichannel detection equipment to increase the rapidity of measurements, an example being the multicounter goniometer in angular correlation measurements. The necessity of an on-line irradiation facility or an isotope separator on-line system (ISOL system) is emphasized for the studies of short lived nuclei. Plans for the future are presented. (auth)

24705 GAMMA SPECTROMETRY AT THE LECI (LABORATOIRE d'ETUDES DES COMBUSTIBLES IRRADIES). Possibilities

Offered by the Integration of a Small Computer into the Analysis Unit. Hulot, J. P.; Mansard, B.; Monier, J.; Roussel, E. (CEN de Saclay, Gif-sur-Yvette, France). Bull. Inform. Sci. Tech. (Paris); No. 174, 15-18(Oct 1972). (In French).

The use of data processing unit TRIDAC C for γ spectrometric analysis enabled very significant improvements to be made in the remote handling of apparatus in cells, the data acquisition possibilities, supervision during measurement, and the analysis of results. (FR)

24706 NEUTRON-GAMMA DISCRIMINATION IN A FAST NEUTRON TIME OF-FLIGHT SPECTROMETER. Seeliger, D.; Seidel, K.; Will, E. (Technische Hochschule, Dresden). Kernenergie; 15: No. 10, 347-353(Oct 1972). (In German).

Owen's space charge discrimination method has been studied theoretically and was applied in a time-of-flight spectrometer for 14 MeV neutrons to reduce the background in inelastic scattering mearurements. With total spectrometer time resolutions of 2.3 ns (when a 33 mm × 25 mm ϕ stilbene crystal was used) and of 3.0 ns (100 mm × 38 mm ϕ liquid scintillator NE 213) an effective suppression of the gamma-rays was achieved from 0.3 to 14 MeV and 1.0 to 14 MeV, respectively; and detection efficiency in these ranges of energy. (auth)

24707 TIME-TO-AMPLITUDE CONVERTER FOR THE NANOSECOND REGION. Gulyamov, M.; Faizullaev, U. I. (Inst. of Nuclear Physics, Tashkent). Izv. Akad. Nauk Uzb. SSR, Ser. Fiz.-Mat. Nauk; No. 4, 59-61(1972). (In Russian).

A nanosecond interval converter was developed for fast neutron spectrometry by the time-of-flight method and operated on time intervals down to 140 nsec. The circuitry permitted measurements to 300 nsec without alterations. The resolving time of the converter circuit was about 0.3 nsec during the use of displaced intervals in time from the short impulse generator. The differential nonlinearity of the combined converter plus analyzer was about ±3%. (tr-auth)

24708 RADIOACTIVITY IN NUCLEAR SPECTROSCOPY. Modern Techniques and Applications. Volume I. Hamilton, J. H.; Manthuruthil, J. C. (eds.). New York; Gordon and Breach, Science Publishers, Inc. (1972). 590p. (CONF-690818-(Vol.1)).

From International Conference on Radioactivity in Nuclear Spectroscopy; Nashville, Tennessee, United States of America (USA). (11 Aug 1969).

After an opening session devoted to the interface of theory and experiment in nuclear spectroscopy, sessions were held on the following topics: Acquisition and analysis of spectra (6 papers), Multiparameter systems and studies of complex decay schemes (10 papers), and In-beam, on-line studies of short-lived states (7 papers). (RWR)

For abstracts of individual papers see: 24652, 24709–24713, 25407, 26166, 26175–26177, 26205–26207, 26276, 26313, and 26352–26354.

24709 PRECISION GAMMA-RAY ENERGY AND INTENSITY MEASUREMENTS WITH Ge(Li) SPECTROMETERS. Heath, R. L. (Idaho Nuclear Corp., Idaho Falls, ID). pp 23-71 of Radioactivity in Nuclear Spectroscopy. Vol. I. Hamilton, J. H. (Ed.). New York; Gordon and Breach, Science Publishers, Inc.

From International Conference on Radioactivity in Nuclear Spectroscopy; Nashville, Tennessee, United States of America (USA) (11 Aug 1969). See CONF-690818-(Vol. 1).

It is presently possible, by using state-of-the-art electronics and Ge(Li) detectors, to measure peak positions on a pulse height scale with a precision approaching one or two parts in 10^5. To achieve this precision in the measurement of gamma-ray energies, however, requires considerable care and an understanding of a number of experimental parameters. Among these are accuracy of calibration standards, system linearity and stability, count rate effect, properties of the detector, data analysis techniques, and proper evaluation of experimental error. The problems encountered in energy measurements over the energy range from a few keV to 10 MeV are discussed in some detail. The current state of suitable calibration reference sources is reviewed, and suggestions are made for further work in this area. The problems encountered in obtaining precise absolute and relative intensities of gamma rays from pulse height spectra are also reviewed in detail. Discussion of instrumental problems, computer data analysis techniques, and detector calibration procedures is included. Current efforts to measure gamma-ray energies and intensities for the Ge(Li) gamma-ray spectrum catalog are reviewed. (16 figures, 8 tables) (auth)

24710 REDUCTION OF INTERNAL CONVERSION ELECTRON DATA. Hennecke, H. J. (Aerospace Research Labs., Wright-Patterson Air Force Base, OH). pp 109-134 of Radioactivity in Nuclear Spectroscopy. Vol. I. Hamilton, J. H. (Ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From International Conference on Radioactivity in Nuclear Spectroscopy; Nashville, Tennessee, United States of America (USA) (11 Aug 1969). See CONF-690818-(Vol. 1).

A description is given of several methods of analyzing internal conversion electron spectra measured with a magnetic spectrometer. All the methods discussed utilize linear least-squares techniques or a suitable linearization for non-linear cases. The primary purpose of all these analysis techniques is to provide systematic methods for the most reliable determination of the intensity of conversion lines from available data and also a reliable estimate of the error limits for this intensity. Consideration is given to the problems associated with time correction of the "single-channel-analyzer-tape" data obtained with magnetic spectrometers and to the combination of multiple scans over a given spectral region for such data. In particular, such corrections become quite complex in the study of internal conversion lines superimposed upon beta continue from a source containing several beta-decaying nuclides with different half-lives. In addition, spectrum stripping techniques utilizing empirical line shapes for a maximum of 5 overlapping lines are presented. The effects of correlations between the overlapping lines, the effects of the position (momentum) uncertainty of the lines, and the effects of empirical line shapes are discussed. Analysis techniques equivalent to those presented are invaluable for the routine analysis of conversion spectra, for the accurate determination of multipolarity mixing ratios and for the accurate measurement of L and M subshell ratios. (auth)

24711 NUCLEAR SPECTROSCOPY VIA Ge(Li) DETECTORS IN COMPTON SUPPRESSION AND PAIR SPECTROMETERS. Camp, D. C. (Univ. of California, Livermore). pp 135-205 of Radioactivity in Nuclear Spectroscopy. Vol. I. Hamilton, J. H. (Ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From International Conference on Radioactivity in Nuclear Spectroscopy; Nashville, Tennessee, United States of America (USA) (11 Aug 1969). See CONF-690818-(Vol. 1).

In the six years that lithium drifted germanium detectors have been available the range of scientific disciplines and problems to which they have been applied is vast and broad. However, the Ge(Li) detectors used for these experiments are primarily of four types and it is important to choose the appropriate type. The relatively small volume of these detectors with their corresponding small peak-to-total and peak-to-Compton ratios led to various combinations of Ge(Li), NaI(Tl), and plastic scintillation detectors which are designed to reduce the Compton distribution. The resulting configurations vary from novelties to highly successful spectrometers. A review of the various configurations, their effectiveness, relative performance and cost is presented. Compton suppression spectrometers are used for a wide number of applications varying from the assay of biological samples to the analysis of lunar samples and selected examples are discussed. Their importance in nuclear spectroscopy is only now being realized and examples are given which highlight the advantages of these types of spectrometers. The electronic logic of such systems has a bearing on the suppression obtained and the essentials are discussed. Some of the configurations use the Ge(Li) detector as the central detector in a three crystal pair spectrometer. This mode of operation is presented with examples of how they provide an explicit means of simplifying complex decay schemes. Several designs for future systems which offer much higher efficiencies and a peak-to-Compton ratio approaching 1000 to 1 for ^{60}Co are presented. (71 references) (auth)

24712 ACQUISITION AND UTILIZATION OF COMPUTERIZED MULTIPARAMETER ANALYZERS IN NUCLEAR SPECTROSCOPY. Black, W. W. (Idaho Nuclear Corp., Idaho Falls, ID). pp 265-312 of Radioactivity in Nuclear Spectroscopy. Vol. I. Hamilton, J. H. (Ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From International Conference on Radioactivity in Nuclear Spectroscopy; Nashville, Tennessee, United States of America (USA) (11 Aug 1969). See CONF-690818-(Vol. 1).

There are several distinct phases involved before a computerized analyzer becomes operational and routinely used. Alternatives available in implementing such a system are examined. Examination of these alternatives is particularly important, because various researchers find themselves in different environments and, therefore, with different boundary conditions. In the acquisition phase a choice must normally be made between ADC-computer systems developed by the computer manufacturers and computerized systems designed by other firms to be used specifically as multichannel analyzers. Other primary considerations are choice of peripheral equipment and costs; costs in terms of both equipment and manpower. After choosing a system, two important

decisions must be made: who is to maintain the equipment, and who is to program the computer. Several decisions must be made in connection with data acquisition: the mode by which the individual events are to be handled, the storage of the multiparameter array, and the means by which the experimental conditions are to be set up and the experiment controlled. Computerized analyzers may be used beyond the data acquisition stage of a multiparameter experiment for data reduction and analysis. Concluding remarks deal with some example systems which illustrate the breadth of approach that is presently available. Some tabular material is included concerning systems that are presently installed in various laboratories and a partial list of computer manufacturers producing computers applicable for use as multichannel analyzers. (auth)

24713 NOTE ON $\gamma-\gamma$ DIRECTIONAL CORRELATION EXPERIMENTS USING A COMPUTER ON-LINE. Salzberg, J. B.; Braden, C. H.; Kendrick, N. S.; Patronis, E. T. Jr.; Wyly, L. D. (Georgia Inst. of Tech., Atlanta). pp 409-413 of Radioactivity in Nuclear Spectroscopy. Vol. I. Hamilton, J. H. (Ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From International Conference on Radioactivity in Nuclear Spectroscopy; Nashville, Tennessee, United States of America (USA) (11 Aug 1969). See CONF-690818-(Vol. 1).

The good energy resolution of a Ge(Li) detector in one channel coupled with the capabilities of an on-line computer system for data acquisition and reduction enable one to detect and take steps to alleviate sources of error inherent in gamma-gamma directional correlation experiments in which a desired gamma peak lies in the presence of a strong coincidence background. Various procedures for data reduction have been investigated in order to better handle small instrumental drifts which may lead to systematic errors in the correlation coefficients. Examples are provided in the decay of ^{125}Sb where preliminary results for the 319 keV-176 keV and 203 keV-176 keV cascades yield $A_2 \approx -0.16$ and $A_2 \approx -0.5$, respectively. (auth)

24714 RECENT DEVELOPMENT OF HIGH RESOLUTION BETA-RAY MAGNETIC SPECTROMETERS. Mladjenovic, M. S. (Boris Kidric Inst. of Nuclear Sciences, Belgrade). pp 581-608 of Radioactivity in Nuclear Spectroscopy. Vol. II. Hamilton, J. H. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From International Conference on Radioactivity in Nuclear Spectroscopy; Nashville, Tennessee, United States of America (USA) (11 Aug 1969). See CONF-690818-(Vol. 2).

Topics include large radial angle spectrometers: $\pi\sqrt{10}$, $(\pi/z)\sqrt{13}$, and winding field spectrometers; correctors; azimuthally varying fields; trochoidal spectrometers; Kelman spectrometers; and performance parameters. (23 references). (WHK)

24715 REVIEW OF SEMICONDUCTORS FOR NUCLEAR PARTICLE AND PHOTON SPECTROMETRY. Mann, H. M. (Argonne National Lab., IL). pp 609-621 of Radioactivity in Nuclear Spectroscopy. Vol. II. Hamilton, J. H. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From International Conference on Radioactivity in Nuclear Spectroscopy; Nashville, Tennessee, United States of America (USA) (11 Aug 1969). See CONF-690818-(Vol. 2).

Present limitations of silicon and germanium detectors arise from deficiencies in both materials and techniques used for fabrication. Further improvement is sought by use of ion-implantation for achieving stable and thin electrical contacts. Refinement of germanium is pursued in order to achieve stability and simplify fabrication and use. Other materials, particularly CdTe, are under study. Development of new detectors requires determination of carrier properties and refinement in crystal growth. Recent progress of interest in nuclear physics applications is described. (auth)

24716 PHOTON SPECTROMETRY IN THE LOW ENERGY REGION OF 500 eV TO 100 keV. Freund, H. U.; Hansen, J. S.; Karttunen, E.; Fink, R. W. (Georgia Inst. of Tech., Atlanta). pp 623-649 of Radioactivity in Nuclear Spectroscopy. Vol. II. Hamilton, J. H. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From International Conference on Radioactivity in Nuclear Spectroscopy; Nashville, Tennessee, United States of America (USA) (11 Aug 1969). See CONF-690818-(Vol. 2).

A critical evaluation of Ge(Li) and Si(Li) detectors at high resolution in the range of ≈3 to 100 keV and of the wall-less gas proportional counter with anticoincidence ring above 500 eV is undertaken. Although the semiconductor detectors have been investigated extensively for high resolution in this energy range, accurate intensity measurements depend upon a knowledge of the absolute detection efficiencies, which are influenced seriously by such effects as escape of characteristic x-rays, dead-layers and surface roughness, detector shape and mounting, carrier-trapping and diffusion in the bulk volume and at the p+-i junction, and scattering phenomena. The gas proportional counter is free of many of these effects and is preferable for intensity measurements below about 3 keV at present. (auth)

24717 HIGH-RESOLUTION GAMMA SPECTROMETER WITH A BORE-HOLE GERMANIUM-DETECTOR. Buker, H. (Kernforschungsanlage, Juelich, Ger.). pp 701-712 of Radioactivity in Nuclear Spectroscopy. Vol. II. Hamilton, J. H. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From International Conference on Radioactivity in Nuclear Spectroscopy; Nashville, Tennessee, United States of America (USA) (11 Aug 1969). See CONF-690818-(Vol. 2).

The fabrication and performance of a lithium-drifted borehole germanium detector for 4π gamma spectroscopy of small low-level samples are described. (WHK)

24718 HIGH PRECISION RELATIVE EFFICIENCY CURVES FOR MEASUREMENT OF GAMMA-RAY RELATIVE INTENSITIES AND INTERVAL CONVERSION COEFFICIENTS. Willett, J. B. (Indiana Univ., Bloomington). pp 1317-1321 of Radioactivity in Nuclear Spectroscopy. Vol. II. Hamilton, J. H. (ed.). New York; Gordon and Breach Publishers, Inc. (1972).

From International Conference on Radioactivity in Nuclear Spectroscopy; Nashville, Tennessee, United States of America (USA) (11 Aug 1969). See CONF-690818-(Vol. 2).

24719 PROPORTIONAL COUNTER SPECTROMETRY AT ENERGIES FROM ZERO TO 500 eV. Genz, H.; Renier, J. P.; Fink, R. W. (Georgia Inst. of Tech., Atlanta). pp 1335-1342 of Radioactivity in Nuclear Spectroscopy. Vol. II. Hamilton, J. H. (ed.). New York; Gordon and Breach Publishers, Inc. (1972).

From International Conference on Radioactivity in Nuclear Spectroscopy; Nashville, Tennessee, United States of America (USA) (11 Aug 1969). See CONF-690818-(Vol. 2).

24720 NaI(Tl) SPLIT ANNULUS FOR COINCIDENCE, ANTICOINCIDENCE, TRIPLE COINCIDENCE, AND PAIR SPECTROMETRY. Kelly, W. H.; McHarris, W. C. (Michigan State Univ., East Lansing). pp 1435-1440 of Radioactivity in Nuclear Spectroscopy. Vol. II. Hamilton, J. H. (ed.). New York; Gordon and Breach Publishers, Inc. (1972).

From International Conference on Radioactivity in Nuclear Spectroscopy; Nashville, Tennessee, United States of America (USA) (11 Aug 1969). See CONF-690818-(Vol. 2).

24721 EFFECTS OF DEVIATIONS FROM CYLINDRICAL SYMMETRY IN LENS SPECTROMETERS USED FOR ELECTRON-GAMMA ANGULAR CORRELATION STUDIES. Holmberg, L.; De Sousa, N.; Stefansson, V.; Petersson, B. G.; Gerholm, T. R. (Univ. of Stockholm). pp 1441-1444 of Radioactivity in Nuclear Spectroscopy. Vol. II. Hamilton, J. H. (ed.). New York; Gordon and Breach Publishers, Inc. (1972).

From International Conference on Radioactivity in Nuclear Spectroscopy; Nashville, Tennessee, United States of America (USA) (11 Aug 1969). See CONF-690818-(Vol. 2).

24722 SIXTEEN-Si(Li)-COUNTER ARRAY FOR THE CHALK RIVER $\pi\sqrt{2}$ β SPECTROMETER. Graham, R. L.; Geiger, J. S. (Atomic Energy of Canada Ltd., Chalk River, Ont.). pp 1447-1448 of Radioactivity in Nuclear Spectroscopy. Vol. II. Hamilton, J. H. (ed.). New York; Gordon and Breach Publishers, Inc. (1972).

From International Conference on Radioactivity in Nuclear Spectroscopy; Nashville, Tennessee, United States of America (USA) (11 Aug 1969). See CONF-690818-(Vol. 2).

24723 TECHNIQUE OF DETECTING CONVERSION ELECTRONS. Fruscello, T. W.; Cothern, C. R. (Univ. of Dayton, OH). pp 1455-1460 of Radioactivity in Nuclear Spectroscopy. Vol. II. Hamilton, J. H. (ed.). New York; Gordon and Breach Publishers, Inc. (1972).

From International Conference on Radioactivity in Nuclear Spectroscopy; Nashville, Tennessee, United States of America (USA) (11 Aug 1969). See CONF-690818-(Vol. 2).

24724 LIQUID SCINTILLATION AND MINICOMPUTER: APPLICATION TO THE DETERMINATION OF TRITIUM IN URINE. Gillet, R.; Regibeau, A. (Univ., Louvain, Belgium). Int. J. Appl. Radiat. Isotop.; 24: No. 1, 51-53(Jan 1973). (In French).

The use of a liquid scintillation spectrometer in conjunction with a separate minicomputer permits the fully automatic determination of tritium activities in urine with very high sensitivity. (UK)

24725 BETA- AND COMPTON-SUPPRESSED SPECTROMETER FOR INTERNAL CONVERSION STUDY. Ishii, M. (Japan Atomic Energy Inst., Tokai). Nucl. Instrum. Methods; 107: No. 2, 227-232(1973).

A beta- and Compton-suppressed spectrometer in which coincidences between internal conversion electrons and K_α x-rays are measured with two Si(Li) detectors has been constructed. Internal conversion in ^{115}In populated in the decays of ^{115m,g}Cd was studied with this spectrometer and the multipolarities of seven transitions were determined. (auth)

24726 VERSATILE SECTOR-FOCUSING MAGNETIC β-RAY SPECTROMETER. Kayser, J. (Univ., Stuttgart). Nucl. Instrum. Methods; 107: No. 2, 301-316(1973).

A K = 0.82 single gap β-ray spectrometer with broad range and high transmission was constructed using a magnetic sector-field $H = H_\phi \sim 1/r$. Rectangular-like pole plates, nearly 640 × 380 mm^2, were used and form a gap width angle $\Delta\phi = 28°$. The maximum entrance angle along the gap amounts to 90°, resulting in a maximum usable solid angle of 4.3%. The geometrical solid angle available amounts to 5.3%. The distance between source and focal point is L = 300 mm. Shaping of the pole plates for a wide range was achieved. Fringing-field effects and the focusing properties are discussed. The foral line for an electron spectrum was investigated. Dispersion, resolution and transmission for differential parts of the gap were determined. A resolution of 1.2% and 2.4% corresponds to the transmission values of 1.1% and 3.0% respectively. The sector-focusing properties for a broad range electron spectrum were investigated. Transmission and dispersion values along the spectrometer axis are presented. An empirical relation between transmission and the usable spectrum range was found. The influence of transmission and dispersion on the upper and lower spectrum range limit is discussed. Absolute transmission functions are presented. The spectrometer is designed for the investigation of $\beta-\gamma$ correlations in forbidden β-decay. (auth)

24727 TIME-OF-FLIGHT RESONANCE COUNTERS IN MOESSBAUER MEASURING SYSTEMS. Chursin, A. A. Meas. Tech. (USSR) (Engl. Transl.); 15: No. 9, 1356-1360(Sep 1972).

Translated from Izmer. Tekh.; 15: No. 9, 47-49(Sep 1972).

The operation and equations describing the relative velocity parameters for time-of-flight resonance counters for studying the Moessbauer effect are discussed. (WHK)

24728 INDUSTRIAL ASSEMBLIES OF NUCLEAR INSTRUMENTS FOR ACTIVATION ANALYSIS. Egiazarov, B. G.; Matveev, V. V.; Sel'dyakov, Yu. P. At. Energ. (USSR); 34: No. 2, 97-104(Feb 1973). (In Russian).

The basic principles of designing activation complexes are considered. It is shown that in the overwhelming majority of cases their designs are similar. The characteristics of individual units of systems for instrumental activation analysis are presented. The possibility of constructing 14 activation assemblies is shown. The basic complexes KOA 1-01 and KAMA 1-01, consisting of units of an aggregate system, are described. These complexes serve to perform two basic tasks of activation analysis. The main parameters of these complexes are given. (auth)

24729 NUCLEAR SPECTROSCOPY AT THE INSTITUTE OF RADIUM. Dzhelepov, B. S.; Zukovskii, N. N.; Ivanov, R. B.; Prikhodtseva, V. P. At. Energ. (USSR); 34: No. 2, 105-109(Feb 1973). (In Russian).

Over the years, a number of magnetic spectrometers for the investigation of α-, β-, and γ-spectra have been constructed in the Nuclear Spectroscopy Laboratory of the Institute of Radium. A considerable amount of data on nuclear decay of various isotopes has been obtained by means of these spectrometers. The stages of magnetic spectroscopy development and measuring possibilities at the present time are discussed. (auth)

24730 GAMMA SPECTROMETER FOR LOW-LEVEL ACTIVITY. Surkov, Yu. A.; Sobornov, O. P. At. Energ. (USSR); 34: No. 2, 125-127(Feb 1973). (In Russian).

A scintillation gamma spectrometer was designed for the investigation of low levels of radioactivity. The background was minimized by the careful selection of Pb, steel, and Cu as shielding materials. The spectra of the background measured with a NaI(Tl) detector measuring 100 × 100 mm with and without anticoincidence are exhibited. Operation of the spectrometer in studying samples of lunar material is described. (KSW)

24731 GAUSSIAN APPROXIMATION TO THE TRANSMISSION FUNCTION OF A TRIPLE-AXIS NEUTRON SPECTROMETER. Quittner, G. (Oesterreichische Studiengesellschaft fuer Atomenergie GmbH, Vienna); Ernst, G. Nucl. Instrum. Methods; 107: No. 3, 461-464(1973).

A previously derived system of equations for a point-by-point calculation of the triple-axis neutron spectrometer transmission function is approximated by another system of equations which is more economic in computer time and convenient for some special applications. This system is equivalent to Cooper-Nathan's equations with the additional advantage of more symmetry and transparency. The accuracy of the approximations underlying this system is estimated in a particular case and weighted against uncertainties arising from other sources. (auth)

24732 SYSTEM OF PROGRAMS FOR THE REDUCTION OF DATA FROM A TIME-OF-FLIGHT SPECTROMETER. Copley, J. R. D.; Price, D. L.; Rowe, J. M. (Argonne National Lab., IL). Nucl. Instrum. Methods; 107: No. 3, 501-507(1973).

A system of Fortran computer programs which are used to process inelastic thermal neutron scattering data from the new "hybrid" time-of-flight spectrometer at Argonne National Laboratory is described. The raw counts are corrected for time independent backgrounds, and for container scattering (taking account of attenuation by the sample), and are normalized to the vanadium cross section. Further corrections, for self shielding and for multiple scattering, are then applied. The scattering function is interpolated to the constant Q representation, and finally a resolution correction is applied. (auth)

24733 ELECTROSTATIC MIRROR SPECTROMETER WITH COAXIAL ELECTRODES FOR MULTI-DETECTOR OPERATION. Wannberg, B. (Univ. of Uppsala). Nucl. Instrum. Methods; 107: No. 3, 549-556(1973).

The focussing of electrons in an axially symmetric electrostatic mirror with $U = U_0(1 + Az) \cdot \ln(r/r_0)$, $r > r_0$; $U = 0$, $r \leq r_0$, is studied with special regard to the possibility of obtaining simultaneous focussing over a wide energy interval. Emission angles of 50 to 65° are studied, and the investigation is limited to the "surface slot" case. It is found that the focal surface can be brought close to the surface of the inner cylindrical electrode (at $r = r_0$) for energies within 7 to 16% of the central energy, and that the useful interval decreases when the emission angle increases. The value of the "shaping parameter" A for which the desired wide range focusing occurs, is strongly dependent upon the emission angle, but the necessary amount of shaping of the outer electrode over the length of the spectrometer is remarkably constant. As in the cylindrical case (A = 0), the size of the instrument in units of r_0 increases very rapidly with the emission angle, while the resolution remains almost constant. The effects of electrons not passing through the symmetry axis are also studied. Their influence on the energy resolution is found to be negligible, but they put a limit to the azimuthal resolution obtainable. (auth)

24734 PEAK LOCATING METHOD WITH STATISTICALLY DEFINED SENSITIVITY. Kajfosz, J. (Inst. of Nuclear Physics, Krakow); Kosina, Z. Nucl. Instrum. Methods; 107: No. 3, 613-614(1973).

The present method is based on investigating the response of an integral function S(F) in addition to a small negative peak at the tested point of the spectrum F. The statistical risk of a fraudulent peak detection is discussed. The method was primarily designed for finding photopeaks in Ge(Li) spectra. (auth)

24735 COMBINATION MAGNETIC-Si(Li), SWEPT-CURRENT ELECTRON SPECTROMETER FOR ON-LINE INTERNAL CONVERSION SPECTROSCOPY. Avignone, F. T. III; Pinkerton, J. E.; Trueblood, J. H. (Univ. of South Carolina, Columbia). Nucl. Instrum. Methods; 107: No. 3, 453-459(1973).

A special wide pass baffle and cooled Si(Li) detector system has been developed and tested for use with a Gerholm triangular field focussed, high transmission lens. The result is an electron spectrometer with an absolute efficiency of greater than two percent and with a transmission-independent energy resolution, dictated only by the quality of the Si(Li) detector and associated electronics. In addition, the instrument is free from γ-ray interferences and summing peaks. The current can be rapidly swept linearly in time to facilitate finding conversion-electron lines and also for use with short lived radioactive sources. The energy resolution is very insensitive to source geometry while the efficiency for detection of conversion electrons is almost independent of energy. The instrument is being developed for on-line operation with an isotope separator. (auth)

High Energy Physics Instrumentation

24736 (CERN-73-2) SPLIT FIELD MAGNET GEOMETRY FIT PROGRAM: NICOLE. Metcalf, M.; Regler, M.; Broll, C. (European Organization for Nuclear Research, Geneva (Switzerland)). 7 Feb 1973. 35p. Dep. NTIS (U. S. Sales Only).

A program is described which will perform the geometrical fit of $pp \rightarrow (n\pi^+)p$ data collected by the Split Field Magnet Detector. Some resolution results are presented, and program extensions for higher multiplicity experiments are indicated. (auth)

24737 (COO-1701-25) TESTS OF TWO INCH DIAMETER PHOTOMULTIPLIER TUBES WITH EXTENDED ULTRAVIOLET RESPONSE. Gingle, A.; Knasel, T. M.; Swallow, E.; Winston, R.; Sumner, R. (Chicago Univ., Ill. Enrico Fermi Inst.; Princeton Univ., N. J. Palmer Physical Lab.). 1 Jul 1972. Contract AT(11-1)-1701. 24p. (CONF-720923-12; EFI-72-30). Dep. NTIS $3.25.

From 16th international conference on high energy physics; Chicago, Illinois, USA (6 Sep 1972).

A series of two inch photomultiplier tubes with extended ultraviolet response for Cherenkov counters were tested in a beam of 1 GeV/c electrons at the ZGS. The test results yield an integral response for the phototube, N_0. The test shows this value can range as high as 174 in a practical threshold counter. The higher the number N_0, the shorter a threshold counter needs to be for the same velocity resolution $\Delta\beta$. Thus the results are generally applicable to the design of very high resolution, or of minimum length Cherenkov counters. (auth)

24738 (FRNC-TH-241) DEVELOPMENT OF A PROGRAM FOR THE PROCESSING OF BUBBLE CHAMBER PHOTOGRAPHS BY COMPUTER IN REAL TIME. Guillon, C. (Paris Univ. (France)). 1971. 208p. (In French). NTIS (U. S. Sales Only).

Thesis.

This program was developed in view of future large bubble chambers although it is equally well applicable to conventional chambers. The program resolves the problem posed by measurements of tracks having nonvisible origins, e.g., γ tracks, V^0 tracks, or neutron stars associated with several events. A description is given of the computer, the peripheral system, and the measurement and data processing system. The logical and mathematical aspects of the measurement program and the data processing system are studied. The supervisory program and the measurement and data processing program are examined. A list is given of the various programs. (FR)

24739 (IFVE-SEF-72-7) HODOSCOPE INSTALLATION FOR INVESTIGATING PARTICLE ELASTIC SCATTERING AT HIGH ENERGY. Borisov, A. A.; Bugorskii, A. P.; Bushnin, Yu. B.; Derevshchikov, A. A.; Dunaitsev, A. F.; Zhil'chenkov, V. D.; Matulenko, Yu. A.; Meshchanin, A. P.; Mikhailov, Yu. V.; Nurushev, S. B.; Sen'ko, V. A.; Smirnov, V. V.; Smirnov, E. V.; Siksin, V. V.; Solov'ev, L. F.; Solov'yanov, V. L. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Serpukhov. Institut Fiziki Vysokikh Energii). 1972. 18p. (In Russian). INIS.

An installation, developed at the Institute of High Energy Physics, overlapped the scattering angle range of 0 to 29 mrad with a resolution of ±0.17 mrad. The total solid angle is 39 μster. The precision of the pulse determination is ±0.22%. The resolution time is 35 nsec. The dead time is 50 μsec. The pass band of the spectrometer is 8%. The speed of collection of statistics is up to 1 million/hr. The installation is electrically connected with the EVM Minsk-22. Preliminary results were obtained on the scattering of π^- mesons on nuclei at momentum of 50 GeV/c and protons in the interval from 30 to 60 GeV/c. (tr-auth)

24740 (JINR-E13-6856) DIGITALLY CONTROLLED FAST LOGIC MODULES. Horvath, P. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1972. 17p. Dep. NTIS (U. S. Sales Only).

Fast logic circuits with the repetition rate of 200 MHz and the time resolution of 10^{-9} s have been digitized using the CAMAC interface. Some results of a project of the fast coincidence system connected to the CAMAC autonomous control system are presented. In the system the operating mode of the coincidence unit and the inherent delay of the logic channels can be set automatically and the stability of the system can be controlled during the experiment. The digital coincidence unit and the digital delay are described. The fast system of coincidence is intended for particle beam identification and triggering of the set of counter hodoscopes in high energy physics experiments. (auth)

24741 (JINR-P1-6878) RESOLUTION OF A FILMLESS SPARK SPECTROMETER ON INVARIANT MASS. Biryulev, V. K.; Vovenko, A. S.; Vestergombi, D. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1973. 16p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

It is shown that the resolution of a spectrometer on invariant mass is stable in time and depends on the decaying kaon momentum. Standard deviations of the mass peak for different momenta are described by the formula $\sigma_{m_{\pi\pi}}(p) = 2.06\ (\mathrm{MeV}) + 0.06 \cdot P\ (\mathrm{MeV/GeV/c})$. It is shown also that the shape of the mass peak can be reproduced by the Monte Carlo method taking into account the experimental errors and the matter on the particle path. (auth)

24742 OPTICAL-IMAGE RECOGNITION FOR EXPERIMENTS IN THE TRACK CHAMBERS OF HIGH-ENERGY PHYSICS. Strand, R. C. (Brookhaven National Lab., Upton, NY). Proc. IEEE (Inst. Elec. Electron. Eng.); 60: No. 10, 1122-1137(Oct 1972).

The problem of extracting data from photographs of the high-energy reactions of subnuclear particles has been studied in the last decade. Four types of film processors have become operational and they have added to the natural excitement of the field by providing ample events to answer questions about the behavior of subnuclear particles. The method of extraction of track-chamber data by specialists is presented; hardware and software are reviewed. Bubble chambers provide the biggest challenge. Higher energy regions and new optical track chambers indicate further challenges for the event-recognition systems. (44 references). (auth)

24743 ILLUMINATION DEVICE FOR OBSERVING THE INTERIOR OF A SEALED ENCLOSURE. Bourdinaud, M. (to Commissariat a l'Energie Atomique). French Patent 2,125,178. 29 Sep 1972. Filed date 17 Feb 1971. 8p. (In French).

An optical illumination device is described. The device is principally intended for observing the interior of sealed enclosures (especially bubble chambers). It consists of a high energy luminous source, and several single fiber light guides having one end in contact with the source; the other ends of these guides are distributed uniformly about the optical axis of the system. An aspheric divergent lens is placed in front of an observation window of the enclosure in order to gather the maximum amount of light from the guides. (FR)

24744 ULTRA-FAST MICROCHANNEL PHOTOMULTIPLIER: THE HR 300. Boutot, J. P. (Laboratoires d'Electronique et de Physique Appliquee, Limeil-Brevannes, France). Acta Electron, 15: No. 4, 271-279(Oct 1972). (In French).

The HR 300 ultra-fast photomultiplier is described. The multiplying structure, which is in the form of a microchannel plate, acts in conjunction with the proximity focusing input optics to give a rapidity in response previously unavailable. The transit time is 1 nsec, the intrinsic time resolution less than 100 psec and the delta-impulse half-height width less than 500 psec. Several experiments in which the speed of the tube response is measured are presented. Several fields of application are discussed, emphasis being given to high-energy physics. (FR)

24745 PROGRESS IN PROJECTION CHAMBERS. Breskin, A.; Charpak, G.; Geissler, K. (CERN, Geneva). Nucl. Instrum. Methods; 107: No. 2, 361-363(1973).

With a simple method of construction, each wire of a "crystal" projection chamber is provided with its own storage capacity. Excellent efficiency for multitracks is obtained. The accuracy is shown to be independent of the orientation with respect to the wire and to be better than 150 μm. The density of discharges is 3/cm for a 5 mm gap, and 5/cm for a 3 mm gap. (auth)

24746 METHOD FOR ELIMINATION OF QUARTZ-FACE PHOTOTUBES IN CHERENKOV COUNTERS BY USE OF WAVE-LENGTH-SHIFTER. Garwin, E. L.; Tomkiewicz, Y.; Trines, D. (Stanford Univ., CA). Nucl. Instrum. Methods; 107: No. 2, 365-370(1973).

The feasibility of the use of organic wavelength-shifters in conjunction with normal glass phototubes and suitably transparent gases in Cherenkov counters was investigated. It was found that such a combination gives performance at least equal to that obtained from quartz-face phototubes.

24747 MAGNETOSTRICTIVE WIRE FOR IMAGE PLANE DIGITIZING OF BUBBLE CHAMBER PICTURES. Bogert, D.; Johnson, M.; Lucas, P.; Ludlam, T.; Sandweiss, J.; Slaughter, J.; Willis, W. (Yale Univ., New Haven). Nucl. Instrum. Methods; 107: No. 2, 337-348(1973).

An inexpensive method of converting conventional scanning tables for bubble chamber film into image plane digitizers with an accuracy of 0.1 mm on the table top is described. (auth)

24748 FIRST PHYSICS RUN WITH A TRACK SENSITIVE TARGET. Coleman, T. G. (Rutherford High Energy Lab., Chilton, Eng.); Fisher, C. M.; Fitzharris, E. W.; Foster, J. H.; Guy, J. G. V.; Williams, P. R.; Leutz, H.; Wenninger, H. Nucl. Instrum. Methods; 107: No. 2, 399-400(1973).

Over one million physics pictures have been taken using a 20 l Track Sensitive Hydrogen Target inside the 1.5 m (500 l) RHEL Cryogenic Bubble Chamber filled with a neon–hydrogen mixture. Both 73 and 77 mol percent neon (radiation length 46 and 40.5 cm) were employed in the mixture. (auth)

24749 TURNING ANGLES OF CHARGED PARTICLE TRACKS IN LARGE BUBBLE CHAMBERS. Knop, R. E. (Florida State Univ., Tallahassee). Rev. Sci. Instrum.; 44: No. 1, 50-52(Jan 1973).

The injection of low energy separated beams into very large bubble chambers, such as the Argonne National Laboratory 12 ft chamber, will have the consequence that many of the secondary

particles will be magnetically trapped within the chamber volume. It is shown that for a highly uniform magnetic field, the turning angle of the tangent to a track of known mass, taken from production to stopping, provides visual estimates of the range to stopping, the total momentum, and the in-flight decay probability. It is also shown that these estimates are independent of depth in the chamber and orientation in the magnetic field, and can be obtained for any view projection in the presence of optical distortions. (auth)

24750 SPARK CHAMBER WITH MULTI-TRACK CAPABILITY. Attenberger, S.; Eickmeyer, J.; Michalowski, S.; Mistry, N.; Padgett, T.; Roberts, L.; Talman, R. (Cornell Univ., Ithaca, NY). Nucl. Instrum. Methods; 107: No. 3, 605-610(1973).

A new type of optical spark chamber, capable of supporting many tracks, is described. The essential new feature is a thin conductive layer over a thin insulation layer which is attached to one of the plates of a conventional chamber. Theory of operation and experimental tests are described. (auth)

24751 SPARK CHAMBER EFFICIENCY IN THE PRESENCE OF VERY SMALL CLEARING FIELDS. Stubbs, R. J.; Breare, J. M. (Univ. of Durham, Eng.). Nucl. Instrum. Methods; 107: No. 3, 601-603(1973).

A method of calculating spark chamber efficiencies in the presence of very small clearing fields, of the order of 1 V/cm, is given and some applications to sealed glass spark chambers are discussed. (auth)

24752 LARGE AREA HIGH EFFICIENCY γ-RAY DETECTOR WITH GOOD TIME AND SPACE RESOLUTION. Abrams, R. J.; Carroll, A. S.; Kycia, T. F.; Li, K. K.; Menes, J.; Michael, D. N.; Mockett, P. M.; Rubinstein, R. (Brookhaven National Lab., Upton, NY). Nucl. Instrum. Methods; 107: No. 3, 569-581(1973).

The construction of a large area high efficiency γ detector for use in the 30 to 1000 MeV range is described. Its basic principle is the combination of lead-scintillator sandwich counters with optical spark chambers to achieve high γ efficiency along with good space and time resolution. The scintillator is arranged in the form of a hodoscope so that the spark chambers could be triggered on a selected number of simultaneous γ-rays. The performance in terms of γ efficiency, energy and direction resolution, and shower development are discussed. (auth)

24753 ERRORS IN MOMENTUM AND DIRECTION OF BUBBLE CHAMBER TRACKS TAKING INTO ACCOUNT ENERGY LOSS. Matt, W. (Max-Planck-Institut fuer Physik und Astrophysik, Munich). Nucl. Instrum. Methods; 107: No. 3, 445-452(1973).

A new method for computing the contribution of measurement and multiple-scattering errors of bubble chamber tracks is described. The improvement over Gluckstern's method is achieved by taking into account energy loss along the track. The new error formulae introduced for the standard mass-dependent fit and the parametrization method are compared with Gluckstern's formulae. For low energy particles, momentum and direction can be determined with greater precision than estimated so far, provided measurements are made over the full track length. (auth)

24754 EXPERIMENTAL IDENTIFICATION OF INDIVIDUAL PARTICLES BY THE OBSERVATION OF TRANSITION RADIATION IN THE X RAY REGION. Harris, F. (Univ. of Hawaii, Honolulu); Katsura, T.; Parker, S.; Peterson, V. Z.; Ellsworth, R. W.; Yodh, G. B.; Allison, W. W. M.; Brooks, C. B.; Cobb, J. H.; Mulvey, J. H. Nucl. Instrum. Methods; 107: No. 3, 413-422(1973).

Transition radiation in the x-ray region produced by 1.3 GeV/c and 3.0 GeV/c electrons has been detected using multi-wire proportional chambers (MWPC). The radiation was generated in eleven stacks of 100 mylar foils (thickness ½ mil. or ⅙ mil.) each preceding one of eleven MWPC placed in line; two inch thick slabs of styrofoam were also used. The incident particles, electrons of π^--mesons, passed through the MWPC as well as the foils. Results are given on the numbers of transition radiation photons detected, the energy deposition in the chambers and the relativistic rise of ionization loss in argon and krypton. The distribution in total pulse height obtained with krypton shows a good separation of π^--mesons and electrons at 3 GeV/c. (auth)

Radiometric Instruments

Refer also to abstracts 24817 and 24820.

24755 RADIATION FILL GAUGE. Martin, P. T. (to Industrial Nucleonics Corp.). U. S. Patent 3,717,760. 20 Feb 1973. Filed date 16 Aug 1965. 8p.

A nucleonic fill gauge for a vessel is provided by mounting a source of radiation inside the vessel to direct radiation in all directions toward the walls of the vessel. A plurality of radiation detectors mounted on the walls around the outside of the vessel respond to radiation passing through the material in the vessel. The signals from each detector are coupled, for example, by light pipe means to a central processor which generates an output signal proportional to the amount of material in the vessel. (Official Gazette)

24756 ADVANCES IN RADIOMETRIC PROCESS CONTROL. Kosmowski, A. (Frieseke and Hoepfner GmbH, Erlangen, Ger. Kerntechnik; 15: No. 1, 16-23(Jan 1973). (In German and English).

The important advances achieved in the field of radiometric process control in recent years were determined by three factors: improved instrumentation, novel applications with the aid of special irradiation techniques, and integration with process computers into complete automation systems. New applications of transmission and backscatter methods and various kinds of measured value outputs are described with particular reference to process automation in the production of paper, cardboard and cellulose and in the plastics and coating industries. Economic considerations and examples illustrate the high rationalisation effectiveness of radiometric measurement and control facilities, the procurement costs of which are often amortised within a few months. (auth)

24757 COMPARATIVE STUDY OF THE ^{147}Pm AND ^{63}Ni ELECTRON CAPTURE DETECTORS UNDER IDENTICAL GEOMETRICAL CONDITIONS. Lubkowitz, J. A., Montoloy, D.; Parker, W. C. (Instituto Venezolano de Investigaciones Cientificas, Caracas). J. Chromatogr.; 76: No. 1, 21-29(Feb 1973).

A detector that is capable of housing either an 8 mCi ^{147}Pm or a 15 mCi ^{63}Ni ionization source was used to compare the electron capture properties of these ionization sources under identical detector geometry. The background current due to the ^{63}Ni source was 2.4 times greater than that obtained for the ^{147}Pm source. Both detectors showed similar linear ranges and electronic absorption coefficients. The ^{63}Ni detector was 1.2 to 1.9 times more sensitive than the ^{147}Pm detector. This difference is small and is due only to the difference in background current. The ^{147}Pm detector showed smaller losses in background current than the ^{63}Ni detector when chromatographing samples that easily contaminate the foils. (auth)

24758 LEVEL METER USING SCATTER OF RADIOACTIVE RADIATION. Ruder, G. (VEN RFT Messelektronik, Dresden). Isotopenpraxis; 8: No. 6, 219-225(Jun 1972). (In German).

A catalog of level metering methods is presented, which is completed by the description of the operating mode, the dimensioning and the construction of a level meter based on the determination of the scatter of gamma radiation in the matter, the level of which is to be measured. Both the radiation source and the detector are arranged in a movable probe covered by a protective tube and placed inside the vessel to follow the level of its contents. (auth)

24759 METHOD OF TESTING GAS OR VAPOUR. Parkinson, R. T.; Wilson, R. E. (to Secretary of State for Defense). English Patent 1,294,853. 1 Nov 1972. Filed date 3 Oct 1968. 8p.

Reference is made to improvements in methods of testing a sample of gas or vapor in order to detect or measure low concentrations of component gases, such as in gas chromatography, where ionization detectors may be employed. It has been found that big increases in ionization detector sensitivity may be achieved by operation of the detector at a low pressure, within a narrow and critical range. The method described comprises forming a mixture of the sample with a pure rare gas having an ionization potential equal to or higher than that of the sample, subjecting the mixture to excitation while at a pressure of 5 to 40 torr to ionize at least a proportion of the sample, and comparing the ionization current from the mixture with that resulting under the same excitation conditions from a stream of the rare gas from which the gas or vapor sample is absent. At least part of the excitation is achieved by ionizing radiation from a radioactive source. The sample may be admixed with the rare gas by eluting with the latter from a gas chromatographic column on which the sample has been absorbed. The rare gas may be He, Ar, or Ne, and the radioactive source may be T, ^{63}Ni or ^{90}Sr. The ionization current is between 10^{-18} and 10^{-5} amps. The required apparatus is described. (UK)

24760 DEVICE FOR DETERMINING THE LEVEL AND SURFACE PROFILE OF MATERIALS UTILIZING HARD RADIATION. Afanas'ev, V. N.; Belyaev, Yu. P.; Gaiduchik, V. O.; Gruzin, P. L.; Konkin, N. A.; Megarskii, V. V.; Okunev, B. N.; Trokin, Yu. A. U. S. Patent 3,718,817. 27 Feb 1973. Filed date 27 Nov 1970.

The device is characterized in that it contains a collimated hard electromagnetic radiation source complete with a servo drive, a collimated reflected radiation receiver also with a servo drive and a means for determining the relative position of the irradiated zone on the inspected surface and the receiving zone. The collimated radiation source has a means for periodically varying the

position of the hard electromagnetic radiation flux relative to the axis of collimation. The means for determining the relative position of the irradiated and receiving zones comprises a phase detector which is electrically connected to the means for periodically varying the position of the radiation flux and serves to route the signal coming from the collimated radiation receiver in accordance with the phase of the control signal coming from the means for periodically varying the position of the radiation flux, and at least two integrating networks which are electrically connected to the phase detector and each of which accepts the signal from the phase detector in accordance with the phase of the control signal. (Official Gazette)

24761 STANDARD METHOD OF TEST FOR MOISTURE CONTENT OF SOIL AND SOIL-AGGREGATE IN PLACE BY NUCLEAR METHODS (SHALLOW DEPTH). ASTM D3017-1972). New York; American Society of Mechanical Engineers (1972). 5p.

This method covers the in situ determination of the moisture content of soil and soil-aggregate by moderation or slowing of fast neutrons where the neutron source and the thermal neutron detector both remain at the surface. (auth)

24762 RATIONALIZATION OF RAIL-BORNE TRAFFIC THROUGH POINT SWITCHING FROM RUNNING LOCOMOTIVES BY MEANS OF RADIOACTIVE RELAYS. Spindler, H. 8: No. 7, 265-266(Jul 1972). (In German).

Point switching from the running locomotive is performed by the engine driver through electrical actuation of the shielding case fitted on the locomotive, thus clearing the trajectory of the beams of a radionuclide. This process is performed when passing a radioactive relay mounted beside the rail track. A suitable combination renders possible the transmission of several signals to be used for setting any desired route. An experimental arrangement is described. (auth)

24763 IMPROVEMENTS IN MEASURING THE DENSITY, VELOCITY, AND MASS FLOW OF GASES. Brain, T. J. S. (TO NATIONAL RESEARCH DEVELOPMENT CORP.). British Patent 1,300,555. 20 Dec 1972. Filed date 28 Mar 1969. 6p.

Apparatus is described for measuring the velocity of gases flowing in a duct, and for measuring the density and/or mass flow of gases. The meter employed includes a radioactive source for ionizing at least part of the gas and first and second electrode systems for collecting the ions. Means are provided for effecting a change in the number of ions collected by the first electrode, together with means for detecting the resultant change in the number collected by the second electrode. Means are also provided to give a signal dependent on the time between the change in the number of ions collected by the first electrode and the time at which a resultant exchange occurs in the number collected at the second electrode, the gas velocity depending on this interval. The radioisotope used may be ^{241}Am or $^{90}Sr/^{90}Y$. Details are given of the electrode systems. The means for effecting a change in the number of ions includes a pulse source adapted to supply a periodic square wave voltage to the first electrode, and the means for measuring the interval includes a suitably connected bistable circuit. Circuitry for indicating gas density and mass flow is also described. Details are given of the method of use. (UK)

24764 RADIOMETRY: LEVEL AND DENSITY MEASUREMENT. Mengelkamp, B. Berlin; Elitera (1972). 171p. (In German).

The physical principles of radioactivity are discussed including the origin of radiation, and the most important properties of detectors. The principles of measurement techniques applied in radiometry (use of radiation properties in industrial measurement techniques) are given. Furthermore, radiation sources such as ^{147}Pm, ^{85}Kr, ^{90}Sr, ^{241}Am, ^{137}Cs, ^{60}Co and practical radiation protection measures, industrial level gages, and ion chamber detectors are described. After a discussion of the principles of density measurements, currently installed density gages are described. The German Radiation Protection Ordinance and other relevant regulations are given. (GF)

24765 THEORY AND APPLICATION OF NUCLEAR WIRE THICKNESS GAGING. Plesch, R. Messtechnik; 80: No. 10, 284-290(Oct 1972). (In German).

The method of nuclear wire thickness gaging is briefly described and its sensitivity and accuracy defined. Subsequently the general theory to determine these two criteria for a measuring method is pointed out. A numerical comparison with measurements on steel and structural steel wires gave satisfactory agreement between theory and practice. The measuring equipment, greatly improves the diameter deviation of the final product. (auth)

Radiation Effects on Instrument Components, Instruments, or Electronic Systems

Refer also to abstracts 26626, 26641, 26647, 26650, and 26669.

24766 (SC-DR-720562) PREDICTING h_{FE} DEGRADATION DUE TO COMBINED NEUTRON-GAMMA ENVIRONMENT USING MLR TECHNIQUES. Burghard, R. A. (Sandia Labs., Albuquerque, N. Mex.). Feb 1973. 111p. Dep. NTIS.

Multiple linear regression techniques were used to develop equations that predict the effects of neutron and gamma irradiation on current gain of bipolar transistors. The study found that the degradation of current gain due to neutrons could be predicted over a wide range of fluence using the prerad measurements of device transit time and current gain. Predictions of gamma irradiation damage on current gain could be made using an irradiation-anneal cycle, where measured current gain after first irradiation is the predicted value after another irradiation which follows the high-temperature anneal. The predicted current gain for a combined neutron-gamma environment is made assuming that the increased base currents resulting from the two environments are independent of each other. (auth)

24767 (SLA-73-123) SANDIA FINAL REPORT FOR JFET AND BIPOLAR TRANSISTOR STUDIES (1 APRIL 1970-31 JANUARY 1972). Oldham, W. G. (California Univ., Berkeley. Electronics Research Lab.). Apr 1972. Contract 57-9992. 90p. Dep. NTIS.

For Sandia Labs., Albuquerque, NM.

The effects of neutron irradiation on n-channel junction field-effect transistors, n^+p junctions, p^+n junctions, and special gated transistors are studied. A theory has been developed for the JFET characteristics as well as for the response of JFET's and simple junctions to ac and transient signals. The observed degradation of n-channel JFET's can be accounted for by a simple effective acceptor level at E_C-0.4 eV, introduced at the same rate as the compensating centers seen in bulk carrier removal. Trapping effect measurements (capacitance-frequency, transconductance-frequency, and large-signal transient measurements) yield accurate energy levels of E_C-0.51, E_C-0.4, and E_C-0.2 eV for the three dominant defects seen. The forward current in special guarded n^+p and p^+n junctions is compared to the theoretical predictions of the hybrid recombination model. A close correlation is found. Using special gated, uniform-base, punch-through transistors, the neutral base damage constant in p-type Si is determined. The injection level dependence is in agreement with Gregory's solar cell measurements, and no fluence dependence of the damage constant is observed. (auth)

24768 FAST LIGHT EMISSION OF ZnS:Cu PHOSPHORS AFTER β IRRADIATION AT 5°K. Luchner, K.; Prestele, K. (Technische Univ., Munich). Phys. Status Solidi (a); 15: No. 2, 477-481(16 Feb 1973).

β-Induced fluorescence of ZnS:Cu phosphors is studied with a time resolution of 10 ns. A strong spike of light emission, superimposed on the general decay within 10 ns after excitation is observed, but mainly in the green emission band. The following general decay is discussed on the basis of the kinetics of donor-acceptor transitions: it is indicated that electrons are trapped with greater probability in the neighborhood of ionized activators. (auth)

24769 CHARACTERISTICS OF INFRARED PHOTODETECTORS PRODUCED BY RADIATION DOPING. Gross, Chris (NASA Langley Research Center, Hampton, Virginia 23365); Mattauch, Robert J.; Viola, Thomas J. Jr. J. Appl. Phys. 44: No. 2, 735-739 (Feb 1973).

High-energy electrons ($\simeq$7 MeV) were used to radiation dope extrinsic silicon. Both n- and p-type silicon photodetectors were fabricated using this doping technique. The 500 °K blackbody responsivity, spectral response, and peak detectivity were determined for these devices. The peak detectivity values measured were 4.8×10^{11} cm $Hz^{1/2}$ W^{-1} at 2.15 μ for 0.1-Ω cm n-type devices and 4.7×10^{11} cm $Hz^{1/2}$ W^{-1} at 4.0 μ for 10-Ω cm p-type detectors. A comparison of the thermally generated background majority carrier concentration for radiation-doped and conventional impurity-doped detectors is made. (auth)

24770 PHOTOVOLTAIC EFFECTS IN THE IONIZATION RESPONSE OF TANTALUM CAPACITORS. Baker, R. T. (Bell Telephone Laboratories, Whippany, New Jersey 07981); Flanagan, T. M.; Leadon, R. E. J. Appl. Phys. 44: No. 3, 995-1002 (Mar 1973).

The response of unbiased tantalum capacitors to ionizing radiation has been measured for both small and large dose rates. The results have

been analyzed using a two-trap model for the Ta_2O_5 dielectric and an equivalent circuit model is presented. A significant reduction in the response of slug capacitors can be achieved by connecting two capacitors in the back-to-back or inverted-parallel configuration. (auth)

Miscellaneous Instruments

Refer also to abstracts 25270, 26632–26634, and 27117.

24771 (AERE-R-7297) CAMAC GLOSSARY. Barnes, R. C. M. (Atomic Energy Research Establishment, Harwell (England)). Nov 1972. 17p. Dep. NTIS (U. S. Sales Only) $3.00. UK 50 pence.

This glossary gives informal definitions of some 130 specialized technical terms used in connection with CAMAC. Full formal definitions of terms underlined in this glossary will be found in the CAMAC Specifications EUR 4100e (1972) and EUR 4600e. Some terms also have a wide usage outside CAMAC, in which case the definitions given reflect the particular shade of meaning in the context of CAMAC. A few terms represent local practice at Harwell; where this is indicated the definitions are not necessarily acceptable to CAMAC users elsewhere. (auth)

24772 (FRNC-TH-206) OPTIMIZATION OF A SYSTEM FOR THE STUDY OF THE GIANT RESONANCE WITH MONOCHROMATIC PHOTONS. Veyssiere, A. (Bordeaux Univ. (France)). 1971. 259p. (In French). INIS.

Thesis.

After having discussed the results of photonuclear experiments, various improvements made to the monochromatic photon production system installed by C. Tzara et al., based on the utilization of the in-flight annihilation of positrons, are presented. The new photoneutron detector equipment is described. The data acquisition system, control, automation, and exploitation of the results are discussed, some examples being given on the supplementary information obtained from this equipment in the measurement of the absolute partial cross sections of heavy nuclei ($A > 100$). The accuracy obtainable in determining the absolute values and the structure is given. (INIS)

24773 (KFK-1655) CAMAC CONTROL MODULE TYPE LEM-52/9.4 FOR A PULSE ADC (12-bit, 50-MHz). Heep, W.; Klein, H. W. (Kernforschungszentrum, Karlsruhe (West Germany). Labor fuer Elektronik und Messtechnik). Jan 1973. 14p. (In German). Dep. NTIS (U. S. Sales Only) $3.00.

A CAMAC module controlling the Series 2200 Analog-to-Digital Converter (ADC) produced by Nuclear Data Inc. is described. The ADC is designed for the US AEC NIM system and therefore needs a control unit for use in CAMAC crates, which connects the ADC to the CAMAC Dataway. (auth)

24774 (KFK-1674) DESIGN CHARACTERISTICS FOR CAMAC MODULES ACCORDING TO THE REVISED SPECIFICATION EUR 4100 e (1972). Heep, W.; Ottes, J.; Tradowsky, K. (Kernforschungszentrum, Karlsruhe (West Germany). Labor fuer Elektronik und Messtechnik). Jan 1973. 28p. (In German). Dep. NTIS (U. S. Sales Only) $3.50.

Following the revised specification EUR 4100 e (1972), general rules for developing CAMAC modules are given. These guidelines give hints to the designing engineer and make possible compatible software for all modules. This paper replaces the Report Externer Bericht 22/71-6. (auth)

24775 (LBL-1(Vol.2)) INSTRUMENTATION FOR ENVIRONMENTAL MONITORING: WATER. (California Univ., Berkeley. Lawrence Berkeley Lab.). 1 Feb 1973. 221p. LBL $7.00.

A comprehensive survey of instrumentation for environmental monitoring is being carried out by the Lawrence Berkeley Laboratory under a grant from the National Science Foundation. Instruments being investigated are those useful for measurements in air quality, water quality, radiation, and biomedicine related to environmental research and monitoring. Consideration is given to instruments and techniques presently in use and to those developed for other purposes but having possible applications to this work. The results of the survey are given as (a) descriptions of the physical and operating characteristics of available instruments, (b) critical comparisons among instrumentation methods, and (c) recommendations of promising methodology and development of new instrumentation. The survey material is compiled in four loose-leaf volumes which will be periodically updated. Volume 2 as initially issued covers metals, biological parameters, oil and grease, and physical parameters. Additional sections on halides and cyanide; nitrogen, phosphorous, and sulfur; pesticides; phenolics; and petrochemicals will be issued in the next few months. (auth)

24776 (RFP-1898) EXOTHERMIC ENTHALPY OF TRIS. Navratil, J. D.; Oetting, F. L. (Dow Chemical U.S.A., Golden, Colo. Rocky Flats Div.). 15 Jun 1972. 15p. (CONF-720730-1). Dep. NTIS.

From 27th annual calorimetry conference; Park City, Utah, USA (19 Jul 1972).

An LKB reaction calorimeter was used to measure the heat of reaction of TRIS (SRM 724) with 0.1 N HCl under conditions recommended by the National Bureau of Standards. The calorimeter was equipped with a separate electrical energy measurement unit for comparison with the LKB system. The results are within the error limits of the certified value of 7115 ± 8 cal/mol. Plans for this calorimeter include measuring heats of solution of nuclear materials. (DHM)

24777 (SC-RR-720783) ELECTRIC CONTACTS: EQUIPMENT AND MECHANICS OF CLOSURE FOR GOLD CONTACTS. Cuthrell, R. E.; Tipping, D. W. (Sandia Labs., Albuquerque, N. Mex.). Dec 1972. 50p. Dep. NTIS $4.50.

Equipment is described and results of a study of the mechanics of closure for gold electric contacts cleaned by sputtering and closed with precise control of mechanical and environmental variables are reported. Measurements include contact resistance, load, contact area, cold welding, creep, anelastic strain recovery, stress-strain, yield stress, strain hardening, hardness, surface symmetry, roughness, and particulate contaminant-size determinations. An ultrahigh vacuum system including vibration isolation, a contact closure micrometer, a load measurement device, sputtering electrodes, an organic thin film deposition device, an interference fringe microscope, and various electronic measurement circuits have been constructed. This equipment and these measurements represent the finest state of the art and the most comprehensive study of the mechanical and electrical aspects of closure for low power, separable, nonsliding electric contacts. (auth)

24778 FAST, CONSTANT FRACTION OF PULSE HEIGHT TRIGGER. Tlachala, V.; Basiladze, S. G. (Joint Inst. of Nuclear Research, Dubna, USSR). Nukleonika; 17: No. 11, 607-612(1972). (In Russian).

A fast trigger of the constant fraction of pulse height type is described. Over 50:1 dynamic range the "walk" is within 0.3 ns for pulses with a rise time of 2.5 ns. The circuit can be used with a rise time of 2.5 ns. The circuit can be used with slow pulses ($t_r \sim 100$ ns). Its proper operation is guaranteed for pulse rates up to 60 MHz. (auth)

24779 MASS-REFLECTRON: A NEW NONMAGNETIC TIME-OF-FLIGHT HIGH RESOLUTION MASS-SPECTROMETER. Mamyrin, B. A.; Karataev, V. I.; Shmikk, D. V.; Zagulin, V. A. (Ioffe Inst. of Physics and Tech., Leningrad). Zh. Eksp. Teor. Fiz.; 64: No. 1, 82-89(Jan 1973). (In Russian).

A description and the operation principle of the mass-reflectron, a new nonmagnetic time-of-flight high resolution mass-spectrometer are given. By combining in a unique manner the merits of time-of-flight mass-spectrometers and high resolution, the mass-reflectron possesses some special properties and in particular that of analyzing substances producing ions with m values of several thousands of atomic mass units. A mass-spectrum of the trimer rhenium bromide ($ReBr_3$)$_3$ with an m reaching 1300 amu is presented which was obtained with the mass-reflectron. The resolution, as judged by the half-width of the peak, is up to 3500. The advantages of the mass-reflectron as compared to time-of-flight mass-spectrometers of the usual type are considered. (auth)

24780 DEVICE FOR MONITORING AND SIGNALLING SMALL OVERPRESSURE AND UNDERPRESSURE VALUES. Scholz, G. (Zentralinstitut fuer Kernforschung, Rossendorf, Ger.). Isotopenpraxis; 8: No. 6, 230-233(Jun 1972). (In German).

A device is described, which provides monitoring of underpressure in boxes and hot cells, in which radioactive and toxic materials are being processed. The metering elements consist of U-tube pressure gages supplied with sealed electrodes. A movable leg renders possible adjustment of preset differential pressure values between 1 and 30 mm of water column with accuracy being ±1 mm of water column. Falling of some parameters below a preset value is indicated acoustically at the measuring point and both acoustically and optionally by a device arranged on the control panel. One device comprises up to 20 measuring points. Its construction is simple requiring little maintenance. (auth)

24781 MODERN DEVELOPMENTS IN FLOW MEASUREMENT. Proceedings of the International Conference held at Harwell, England, September 21–23, 1971. Clayton, C. G. (ed.). PPL conference publication 10. London; Peter Peregrinus Ltd. (1971). 406p. (CONF-710980-).

From International conference on modern development in flow measurement; Harwell, UK (21 Sep 1971).).

Thirty papers were presented at the conference. A separate abstract was prepared for each of 5 papers. The remaining papers were not within scope of NSA. (TFD)

For abstracts of individual papers see: 24782 through 24786.

24782 DEVELOPMENT OF THERMAL FLOWMETERS FOR THE MEASURMENT OF SMALL FLOWS OF CORROSIVE AND RADIOACTIVE LIQUORS IN CHEMICAL PLANTS. Mills, A. L.; Evans, C. R. A.; Chapman, R. A. (United Kingdom Atomic Energy Authority, Dounreay, Scotland). pp 105-114 of Modern Developments in Flow Measurement. Clayton, C. G. (ed.). London; Peter Peregrinus Ltd. (1971).

From Conference on modern developments in flow measurement; Harwell, England (21 Sep 1971). See CONF-710980-.

The necessity to measure accurately low flows of nitric acid, organic solvents or radioactive liquids requires the use of very reliable flowmeters. The general requirement for such an instrument is that it should require no routine maintenance and should be corrosion free. There should be no restrictive orifice or moving parts, but an electrical output should be available for control or alarm. In addition the unit should be fail safe; particularly, liquor flow must not be obstructed under failure conditions. A series of thermal flowmeters which fulfill these requirements has been developed by the United Kingdom Atomic Energy Authority, at Dounreay. These have been installed in the fast reactor processing plant where liquor flows, including 16 N nitric acid have been measured over a range 0.05 to 20 liters hr with an accuracy of ±2%. The principle of operation, construction, application and operating characteristics of the thermal flowmeter are described. (auth)

24783 DEVELOPMENT OF A PULSED GAS IONIZATION FLOWMETER. Brain, T. J. S. (National Engineering Lab., East Kilbride, Scotland). pp 236-244 of Modern Developments in Flow Measurement. Clayton, C. G. (ed.). London; Peter Peregrinus Ltd. (1971).

From Conference on modern developments in flow measurement; Harwell, England (21 Sep 1971). See CONF-710980-.

Tests have been carried out to assess the feasibility of a novel gas ionization technique for flow velocity measurement. Air at conditions close to ambient was used as the test fluid. The device was located in a 152 mm (6 in.) diameter pipeline and a Borda inlet was used to calibrate the instrument against flow velocity within the range 5 to 25 m/s (16 to 82 ft/s). The results show that even at this preliminary stage the meter is capable of accuracies better than ±2.5 per cent. The instrument has a linear calibration and, since it presents little obstruction to the flow, head losses are small. (auth)

24784 MEASUREMENT OF GAS FLOW BY RADIOTRACER METHODS. Evans, G. V.; Spackman, R.; Aston, M. A. J.; Clayton, C. G. (Atomic Energy Research Establishment, Harwell, Eng.). pp 245-260 of Modern Developments in Flow Measurement. Clayton, C. G. (ed.). London; Peter Peregrinus Ltd. (1971).

From Conference on modern developments in flow measurement; Harwell, England (21 Sep 1971). See CONF-710980-.

The radioisotope constant-rate-injection method and the integrated-pulse-velocity method of measuring accurately the flow rate of gases are described. The accuracy of these methods has been established by comparisons with a primary standard of gas flow measurement based on a gas collection technique and associated with 5 cm diam and 10 cm diam pipelines having flowrates of air up to 20 m^3/min. Accuracies of better than ±0.2% at the 95% confidence level have been demonstrated. The application of these techniques to the in-situ calibration of flow meters and to the performance testing of large fans is also described. (auth)

24785 FLOWRATE DETERMINATION BY NEUTRON ACTIVATION ANALYSIS. Boswell, C. R.; Pierce, T. B. (Atomic Energy Research Establishment, Harwell, Eng.). pp 264-272 of Modern Developments in Flow Measurement. Clayton, C. G. (ed.). London; Peter Peregrinus Ltd. (1971).

From Conference on modern developments in flow measurement; Harwell, England (21 Sep 1971). See CONF-710980-.

Neutron activation analysis was used to measure the velocity of liquids, solids and slurries by counting the induced radioactivity formed in the moving material as a result of neutron irradiation. Two methods were used, one measuring the ratio of the activity of the stream at two positions downstream of the place of irradiation and the other measuring the time taken for activity formed by a neutron pulse to travel between source and detector. (auth)

24786 ELECTROMAGNETIC FLOWMETERS FOR LIQUID METALS. Thatcher, G. (United Kingdom Atomic Energy Authority, Risley, Eng.). pp 359-380 of Modern Developments in Flow Measurement. Clayton, C. G. (ed.). London; Peter Peregrinus Ltd. (1971).

From Conference on modern developments in flow measurement; Harwell, England (21 Sep 1971). See CONF-710980-.

Two different types of flowmeters, suitable for use in large-scale liquid metal systems, such as liquid-metal, fast breeder reactors are described. Theoretical and experimental evidence is presented to show how transverse field electromagnetic flowmeters become non-linear when applied to large liquid metal systems. The saddle coil flowmeter, designed to overcome this problem and to obviate the need for calibration, is fully described, together with exhaustive tests on a prototype. The second flowmeter to be described is the flux distortion type. A numerical analysis of this type is presented, followed by the results of extensive laboratory tests on production models. (auth)

24787 SPECIMEN TEMPERATURE INCREASES DURING TRANSMISSION ELECTRON MICROSCOPY. Thornburg, D. D.; Wayman, C. M. (Univ. of Illinois, Urbana). Phys. Status Solidi (a); 15: No. 2, 449-453(16 Feb 1973).

New measurements of temperature rises in electron-irradiated transmission-microscopy specimens were made by employing Au-Ni thin film thermocouples prepared by vacuum evaporation onto thin mica discs. The extent of heating is proportional to the electron flux (beam current) and for typical 100-kV operating conditions in the microscope is less than 8°K. Under extreme conditions (100 μA), temperature increases on the order of 15°K were observed. (auth)

24788 POSTERIORI DETERMINATION OF TEMPERATURE USING THE MEMORY EFFECT. Blanchard, P.; Gayet, B.; Peray, R. (CEN de Cadarache, Saint-Paul-les-Durance, France). Bull. Inform. Sci. Tech. (Paris); No. 175, 45-53(Nov 1972). (In French).

The difficulty of measuring temperature continuously inside a reactor has led to the use of indirect methods, the temperature reached being found by measuring the variation of certain phenomena or properties of materials as a function of temperature. The following methods are examined; diffusion of oxygen in Zr, diffusion of Al in Mg, and absorption of ^{85}K in steel. The advantage of this method is that it uses either the experimental material or a monitor which can be introduced anywhere inside the reactor. (FR)

24789 CAMAC ACTIVITIES IN THE NETHERLANDS. Van Den Berg, P. C. (comp.) CAMAC Bull.; No. 5, 17-18(Nov 1972).

CAMAC activities of six institutions in the Netherlands are described. The institutions include the Cyclotron Laboratory University of Technology Eindhoven, FOM-Instituut voor Atoom-en Molecuulfysica, Amsterdam, FOM-Institute for Plasma Physics Rijnhuizen Jutphaas, Institute for Nuclear Physics Research (IKO), Amsterdam, Interuniversitair Reactor Instituut (I.R.I.) Delft, and Reactor Centrum Nederland (R.C.N.) Petten. (EU)

24790 IMPROVEMENTS IN OR RELATING TO ION SOURCES. Elliot, R. M. (to Associated Electrical Industries Ltd.). British Patent 1,298,940. 6 Dec 1972. Filed date 28 Apr 1969. 4p.

Reference is made to ion sources for use in conjunction with mass spectrometers. A disadvantage common to most such ion sources is that, due to their field configurations, ions dwell within the ion source for a period of the order of one to ten μs, and various disadvantages arise from this, including an unsatisfactorily small number of molecular ions available for analysis. The object of the ion source described is to enable ions to be expelled rapidly. The material is ionized by a method other than field ionization and the ions are subjected to an electric field produced by a charged tip, blade, wire, or similar sharp edge or point, the electric field preferably being below the intensity required to cause substantial field ionization. The material is preferably ionized by electron bombardment, or UV radiation may be used; the latter has the advantages of not disturbing the configuration of the electric field used for rapid ion expulsion. Where the ionization means is electron bombardment, electric and/or magnetic fields within and adjacent to the ion chamber should be such that electrons and ions follow different trajectories, whereby ions formed by electron bombardment do not collide with the electron source. (UK)

24791 ALPHA-RECOIL SPECTROSCOPY OF HEAVY-ION REACTION PRODUCTS. MacFarlane, R. D.; Torgerson, D. F.; Pape, A. (Texas A and M Univ., College Station). J. Phys. (Paris), Colloq.; No. 5, 95(1972).

Recent interest in the production and identification of isotopes of a predicted new region of superheavy elements has stimulated the development of a new approach to on-line mass analysis, which couples the measurement of the mass of a decaying species with its nuclear radiation. The system was tested using α-particle emitters of Dy, Ho, and Er produced in compound-

nucleus reactions of the $^{144}Sm + ^{12}C$ system. Mass assignments of $^{152,153}Er$, ^{152}Ho, and ^{150}Dy have been verified. (FR)

24792 CONTROL SYSTEM FOR CASCADE PROCESSORS. Khan, M. S. (Atomic Energy Centre, Dacca, Pakistan). Nucl. Instrum. Methods; 107: No. 2, 349-355(1973).

A control system to be associated with cascade working processing units is designed with a graphical method which is suitable for a system design using threshold controlled integrated circuits. This graphical method, still under research in Bangladesh Atomic Energy Commission, Dacca, is briefly described. Only three elementary operations to be assigned to each control operator are discussed including data acquisition, processing, and results availability. The concept can be extended to still more complex operators. (auth)

24793 COMMENT ON DEAD-TIME LOSSES IN A BUFFERED DATA RECORDING SYSTEM. Bell, R. E. (McGill Univ., Montreal). Nucl. Instrum. Methods; 107: No. 2, 395(1973).

This note comments on a recent paper of Øveras (Nucl. Instr. and Meth. 104(1972) 85) and points out that some of the same calculations had in fact been published earlier. (auth)

24794 DESIGN OF A CAMAC DIALOGUE UNIT. Barrier, E.; Meyer, J. M.; Metzger, G. (Centre de Recherches Nucleaires, Strasbourg). Nucl. Instrum. Methods; 107: No. 2, 407-411(1973). (In French).

A CAMAC module intended for dialogue between a CAMAC System Controller and a physicist is described. It allows the remote control through CAMAC of an experiment. The unit is composed from a keyboard, a Tektronix 611 Display, a Display Controller and a CAMAC Interface Module. CAMAC reading of up to 4×14 bits and CAMAC writing of 2×7 bits, in one sequence, is allowed. (auth)

24795 NEW LARGE-APERTURE ENERGY ANALYZER. Marmet, P. (Univ. Laval, Quebec). Rev. Sci. Instrum.; 44: No. 1, 67-70(Jan 1973).

A new instrument is described which permits focusing and energy analysis of electrons or any other charged particle, coming from a source having a large area. This instrument is specially convenient to measure an electron energy spectrum when a very large sensitivity is required, because the electron optics are such that the entrance slit is no longer required. (auth)

24796 CAPACITIVE INTEGRATION SYSTEM FOR THE PRECISE MEASUREMENT OF ISOTOPIC RATIOS IN A MASS SPECTROMETER. Jackson, M. C.; Young, W. A. P. (Atomic Weapons Research Establishment, Aldermaston, Eng.). Rev. Sci. Instrum.; 44: No. 1, 32-34(Jan 1973).

An automated data collection system has been developed and applied to the measurement of $^{16}O/^{18}O$ ratios with high precision. The design is based on the simultaneous capacitive integration of two ion beams from a mass spectrometer. The results obtained have shown a consistent precision of 10 to 20 ppM. (auth)

24797 PLANS FOR A TWO-STAGE SEPARATOR OF UNSLOWED PRODUCTS OF HEAVY ION REACTIONS. Eichler, W.; Ewald, H.; Guettner, K.; Hinckel, P.; Muenzenberg, G.; Nickel, F.; Wollnik, H. (Univ., Giessen, Ger.). J. Phys. (Paris), Colloq.; No. 5, 178(1972).

The two-stage separator developed by the Gesellschaft fuer Schwerionenforschung is briefly described. (FR)

24798 DESIGN CONSIDERATIONS OF THREE- AND FOUR-STAGE APERIODIC RF MASS SPECTROMETER WITH IMPROVED PERFORMANCE CHARACTERISTICS. Lall, H. B. (Guru Nanak Engineering Coll., Ludhiana, India). Nucl. Instrum. Methods; 107: No. 3, 541-548(1973).

The present work deals with the choice of dimensional as well as operational parameters for the design and development of three- and four-stage configurations of the aperiodic rf mass spectrometer. The analysis of the two analyzer configurations has been carried out with square as well as complex wave-form of the rf signal voltage. The data thus obtained leads to a considerable improvement of resolution. The variation of resolving power, of a specific analyzer configuration, has been determined as a function of the amplitude-coefficient, β, of the added harmonic to the rf signal voltage. The course of the energy-modulating functions has been investigated and position and relative level of the secondary maxima determined. A conveniently adjustable analyzer assembly has been designed and developed. (auth)

24799 COMPOSITE FOCUSING NEUTRON MONOCHROMATOR SYSTEM. Boeuf, A.; Rustichelli, F. (Institut Max von Laue Paul Langevin, Grenoble, France). Nucl. Instrum. Methods; 107: No. 3, 429-435(1973).

A composite focusing neutron monochromator system consisting of fifteen curved silicon crystals has been developed. A curvature radius of about 20 m was obtained in each silicon disk by forming a film of Si_3N_4 on one of its faces. The silicon crystals, having a thickness of 0.5 mm and a diameter of 40 mm, were cut in such a way that an angle of 10° exists between the surface of the crystal and the (111) reflecting plane. Each crystal can be oriented independently of the others around two perpendicular rotation axes. In the composite monochromator system, the silicon lamellas were each inclined with respect to the adjoining one in such a way that a focusing effect for the diffracted neutron beams was obtained at a distance of 130 cm. In the momentum space this system determines a transformation of a parallel polychromatic beam into a diffracted beam in which the neutron movement is dependent on the secondary ray direction; the total relative width of the energy range of the focused neutrons is $\Delta E/E \approx 12\%$. The optimization of the neutron focusing effect was carried out by taking polaroid pictures at different distances from the composite system. By positioning a BF_3 counter at the focusing point, it has been verified that the neutron intensity is a linear function of the number of crystals used. Finally a spectral analysis of the focused neutron beam has been performed by means of a perfect silicon crystal analyzer. (auth)

24800 ISOTOPE SEPARATOR IMPLANTATION OF RADIOACTIVE IONS FOR HYPERFINE INTERACTION STUDIES. Bernas, H.; Obert, J. (Paris Univ., Orsay, France). Nucl. Instrum. Methods; 107: No. 3, 423-428(1973).

The standard methods of radioactive isotope separation have been adapted to the necessities of hyperfine interaction experiments: post-acceleration of the separated beam, low total dose, and high mass resolution. Target preparations are briefly described, as well as results on dose, penetration, and effect of implantation energy. (auth)

ISOTOPE AND RADIATION SOURCE TECHNOLOGY

Isotope Separation (Industrial)

Refer also to abstracts 24360, 25266, and 25267.

24801 (JINR-E13-6672) VERSATILE ION SOURCE FOR THE RADIOACTIVE ISOTOPE SEPARATION. Bystrov, V. A.; Latuszynski, A.; Raiko, V. I.; Tyrroff, H. (Joint Inst. for Nuclear Problems). 1972. 8p. (CONF-720948-11). Dep. NTIS (U.S. Sales Only).

From 2nd international conference on Ion sources; Vienna, Austria (11 Sep 1972).

The construction of an ion source with surface ionization and hollow cathode gas discharge is described. Three variants of the ion source are discussed. The first experimental results are given for one variant. Ion current density of Ia/cm^2 and efficiency of ~13% for Xe were obtained. Methods for increasing the efficiency of the device are also discussed. (auth)

24802 (KFK-1647) EXPERIMENTAL INVESTIGATION OF THE STABILITY RELATION OF A 10-STAGE SEPARATION NOZZLE CASCADE BY PERIODIC DISTURBANCE OF THE OPERATING CONDITIONS. Linder, G.; Schuette, R. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Kernverfahrenstechnik). Jul 1972. 55p. (In German). Dep. NTIS (U. S. Sales Only) $4.75.

The influence of periodic disturbances of all essential plant operating variables on the stability of the 10-stage separation nozzle pilot-plant was examined. Therefore sinusoidal and triangular-shaped periodic variations in the values of the UF_6-feedback rate U_3, the He-feedback rate τ_Z and the UF_6-separation feed pressure p12 were performed with frequencies from 0.0005 to 0.5 cycles per second by means of the regulators in the UF_6-separation system at the top of the square cascade. Furthermore, rectangular-shaped periodic changes of the stage cut and of the compression ratio of a compressor were produced in single stages in the middle of the cascade within the same frequency range. As a measure for the periodic disturbances, a frequency analysis of the inlet pressures p_0 in all stages of the pilot-plant was performed. In the course of the measurements no resonance frequencies were observed. During the periodic variations of the plant operating variables, the separation nozzle cascade behaved as a stable, extremely damped system, in which the amplitudes decreased with increasing frequency and with increasing distance from the disturbance point. The influence of the periodic disturbances in a single stage was confined to a few stages above and below the disturbance point according to the effects of stationary changes. This confinement was more pronounced with increasing frequency, while the amplitudes decreased reciprocally with frequency. However, the propagation of these disturbance effects proceeded independent of frequency with a short range velocity of about 0.3 stages per second for changes in the compression ratio and of about 1.8 stages per second for changes in the cut. (auth)

24803 GAS SEPARATION BY MEANS OF CIRCULATION DIFFUSION. PART 1. HIGH GAS ENRICHMENT IN SEPARATION TUBES WITH NATURAL CIRCULATION. Koenig, P.; Wolf, F.; Lange, F. (Martin-Luther Univ., Halle, Ger.). Isotopenpraxis; 8: No. 10, 382-390(Oct 1972). (In German).

Two separation tubes for high gas enrichment were developed on the basis of the circulation diffusion principle. H_2-N_2, $Kr-CH_4$, and air served as model gas mixtures. Besides steam, methanol and ethanol vapor were used as propellants. Favorable separation was obtained with a tube having a length of only 20 cm with its separation slit being subdivided into small horizontal sections by means of laminae, and into two vertical toroids by means of a wire diaphram. Three tubes of this type were tested in rectangular cascade arrangement. The theory of transport in the separation tube as well as the treatment of hydrodynamic problems are indicated. The use of the separation tube for isotope separation and for high gas enrichment seems to be a promising approach. (auth)

Isotopic Power Sources

Refer also to abstract 24816.

24804 (ARCO-3057-11) RADIOISOTOPE POWERED CARDIAC PACEMAKER PROGRAM. Quarterly Progress Report, November 1, 1972–January 31, 1973. (Arco Nuclear Co., Leechburg, Pa.). 1973. Contract AT(11-1)-3057. 55p. Dep. NTIS $3.00.

Progress in the development of radioisotope-powered cardiac pacemakers is reported. 36 pacemakers were completed for future human implantation. 30 units implanted in animals continued to operate properly. Plans to sterilize 52 units for human implantation were formulated. Information is included on reliability and quality assurance testing, systems fabrication, systems testing, and safety evaluation under cremation conditions. (LCL)

24805 (ORNL-3741) LITERATURE SURVEY AND EVALUATION OF THE BORIDES AS ISOTOPIC POWER SOURCE COMPOUNDS FOR ^{144}Ce, ^{147}Pm, ^{90}Sr, ^{242}Cm, ^{244}Cm, AND ^{238}Pu. Rimshaw, S. J. (Oak Ridge National Lab., Tenn.). Dec 1964. Contract W-7405-eng-26. 28p. Dep. NTIS $3.50.

Declassified 29 Mar 1973.

The available literature data are reviewed in order to determine the suitability of the borides as source compounds for ^{144}Ce, ^{147}Pm, ^{90}Sr, ^{242}Cm, ^{244}Cm, and ^{238}Pu. It was found that the rare earths and actinides form borides which are stable in vacuum at high temperatures, and do not undergo phase transitions with an increase in temperature. The borides are metallic in nature with a high thermal conductivity which increases with increasing temperature. Silicon, boron, or silicides can be added to the borides to increase the mechanical strength. Pressure sintering (or hot pressing) must be used to form the borides into useful shapes. The fast neutron yield from the (α,n) reaction on boron is about the same as the fast neutron yield from the spontaneous fission of ^{244}Cm, and exceeds the fast neutron yield from the spontaneous fission of ^{242}Cm by a factor of 10 or more. In this respect, the borides are an undesirable source of fast neutrons. Power densities are tabulated for the borides, carbides, nitrides, silicides, phosphides, sulfides, oxides, and metals and other compounds of ^{144}Ce, ^{144}Pm, ^{238}Pu, ^{242}Cm, ^{244}Cm, ^{90}Sr, ^{137}Cs, and ^{210}Po. Thermal and physical data are presented for CeB_6, PmB_6, SrB_6, and PuB_6. No data are available for CmB_6. (auth)

24806 (SNSO-3063-1) STANDARDIZATION AND ECONOMICS OF NUCLEAR SPACECRAFT. Executive Summary. Final Report: Phase I, SENSE Study. (Fairchild Industries, Inc., Germantown, MD (USA)). 5 Jan 1973. Contract AT(49-15)-3063. 61p. Dep. NTIS $5.25.

Feasibility and cost benefits of nuclear-powered standardized spacecraft were investigated. The study indicates that two shuttle-launched nuclear-powered spacecraft should be able to serve the majority of unmanned NASA missions anticipated for the 1980's. The standard spacecraft include structure, thermal control, power, attitude control, some propulsion capability and tracking, telemetry, and command subsystems. One spacecraft design, powered by the radioisotope thermoelectric generator, can serve missions requiring up to 450 watts. The other spacecraft design, powered by similar nuclear heat sources in a Brayton-cycle generator, can serve missions requiring up to 2200 watts. Design concepts and trade-offs are discussed. The conceptual designs selected are presented and successfully tested against a variety of missions. The thermal design is such that both spacecraft are capable of operating in any earth orbit and any orientation without modification. Three-axis stabilization is included. Several spacecraft can be stacked in the shuttle payload compartment for multi-mission launches. A reactor-powered thermoelectric generator system, operating at an electric power level of 5000 watts, is briefly studied for applicability to two test missions of diverse requirements. A cost analysis indicates that use of the two standardized spacecraft offers sizeable savings in comparison with specially designed solar-powered spacecraft. The savings are in addition to those to be realized by the component and subsystem standardization program. (auth)

24807 NEUE ENERGIESYSTEME FUER DIE RAUMFAHRT. (New Energy Systems for Space Flight). Peschka, W. Munich; Wilhelm Goldmann Verlag (1972). 212p. $10.75.

Energy requirements for space applications are examined. Chemical energy sources are suitable in cases in which a high power is needed for short time intervals. One of the most important energy sources is provided by solar radiation. The characteristics of nuclear energy are also considered, taking into account radioisotopes and processes based on fission or fusion. Devices for the conversion of energy include electrochemical systems of various types, photoelectric systems, thermoelectric systems, thermionic systems, and mechanoelectrical systems. The design of energy systems of various types is discussed, taking into account photovoltaic devices, nuclear space power systems, and magnetogasdynamic systems. (IAA)

24808 RADIOISOTOPE HEAT SOURCES FOR POWER APPLICATIONS. Enomoto, Shigemasa (Japan Atomic Energy

Research Inst., Tokai). Proc. Jap. Conf. Radioisotop.; No. 10, 247-248(Apr 1972). (In Japanese).

From Tenth conference on radioisotopes; Tokyo, Japan (16 Nov 1971).

The radiation energy of radioisotopes may be utilized as both heat and electricity. A variety of such applications in the world is first reviewed. RI heat sources in their general meaning have the following features: compact structure and extended life, good safety aspects, and competitiveness in cost with other heat sources. Most important of these is the safety, especially in the severe conditions of environment. In this respect, capsules containing radioisotopes or radiation sources play a role. In the case of using ^{90}Sr fission products recovered as a heat source, a compound $SrTiO_3$ in ceramic form is most desirable because of its thermal and chemical stability. Recent study in JAERI in this connection is mentioned. On the other hand, recent advance of ^{238}Pu with its alpha emission as a heat source is remarkable. (JA)

24809 RADIOISOTOPIC POWER GENERATORS. Feasibility Study and Economic Aspect. Ishimatsu, K. (Hitachi Ltd., Kawasaki, Japan). Proc. Jap. Conf. Radioisotop.; No. 10, 249-251(Apr 1972). (In Japanese).

From Tenth conference on radioisotopes; Tokyo, Japan (16 Nov 1971).

The amount of radioactive wastes is progressively increasing with the advance of nuclear power generation. Recovery of individual fission products from these wastes involves complicated chemical processes. As a means of obtaining energy for electric power generation, the use of mixed fission products (MFP) is highly desirable. Its drawback is the initial high gamma activity, while it has outstanding advantage in cost, that is, purposes of disposal and of utilization are in the same line. For the purpose of power generation with MFP, the concept of semiconductor thermoelectric generation is mostly used. In Japan, the future use of such generators will be mainly on the earth, such as navigational markers and automatic meteorological stations. (JA)

24810 ENERGY SOURCES FOR BIOLOGICAL IMPLANTATION. Atsumi, K. (Tokyo Univ.). Proc. Jap. Conf. Radioisotop.; No. 10, 252-254(Apr 1972). (In Japanese).

From Tenth conference on radioisotopes; Tokyo, Japan (16 Nov 1971).

In artificial, i.e., man-made, human organs, driving energy is required; for example, in those organs placed outside human body and replacing human function for an extended period, those replacing temporarily or partly the human function, and those whose studies have been recently started, except artificial blood vessels, valves, and bones. As typical examples of the use of radioisotopes for such purposes, artificial hearts and heart pacemakers are described. For the former, ^{238}Pu is used; that is, by means of its decay heat, the artificial heart is operated as a steam engine in conformity with the Rankine cycle. Requirements for radiation sources are also listed, and a comparison in cost is made with a battery. In the pacemaker, to maintain the rhythm of the heart, the nerve concerned is excited electrically. For this purpose, ^{238}Pu or Pm, for example, is used. Finally, the future problems involved in such heart devices are explained, e.g., those concerning medicine, engineering, and economy. (JA)

Radiation Sources

Refer also to abstracts 24526, 24555, 24641, 24669, 24757, and 24759.

24811 CONSTRUCTION AND TESTING OF AREA RADIATION SOURCES AS SECONDARY NORMALS FOR CHECKING CONTAMINATION METERS FOR BETA-RADIATORS, AND FOR CERTIFICATION OF AREA RADIATION SOURCES AS NORMALS. Guehne, F. (Deutsches Amt fuer Messwesen und Warenpruefung, Berlin). Isotopenpraxis; 8: No. 6, 201-207(Jun 1972). (In German).

Two sets of area radiation sources with $^{90}Sr/^{90}Y$, ^{204}Tl, and ^{60}Co as beta-radiators were manufactured to test contamination meters and to certify area radiation sources as normal. The applied manufacturing process providing deposition of one drop of a radioactive solution on each field of a preset grid rendered possible both rather uniform distribution of the radioactive matter throughout the source surface, and direct determination of area activity values. The particular construction of the area radiation sources allows simple determination and elimination of measuring errors caused in contamination meters by the material carrying the active matter, and the thickness of the active layer. (auth)

24812 USE OF THE ISOMERIC NUCLEUS ^{235m}U AS A PROBE FOR SURFACE ADSORPTION AND DESORPTION STUDIES. Paper No. 10. Neve de Mevergnies, M. (CEN, Mol, Belgium). Vacuum; 22: No. 10, 463-465(Oct 1972).

When ^{235m}U nuclei are deposited on a metallic surface, they exhibit two distinct nuclear decay constants, corresponding most probably to chemisorbed atoms and to physisorbed oxide molecules, respectively. In addition, when the ^{235m}U source is placed under vacuum, the analysis of the decay rate of the surface activity can yield the mean sticking time and the heat of adsorption of the physisorbed molecules; it also gives information on the conversion electron spectrum of the desorbing ^{235m}U nuclei. Results obtained with ^{235m}U adsorbed on Pt, Cu, and Ti are presented. (auth)

24813 NEW TRENDS IN ISOTOPE APPLICATION TECHNIQUES IN THE UNITED STATES. Fowler, E. E. (Div. of Isotopes Development, Washington, DC). Proc. Jap. Conf. Radioisotop.; No. 10, 13-22(Apr 1972).

From Tenth conference on radioisotopes; Tokyo, Japan. (16 Nov 1971).

Significant developments and trends in radioisotope and radiation technology in the United States since the 9th Conference on Radioisotopes are reviewed. Emphasis is placed in those aspects derived from the following three singular developments in recent years, i.e., pollution problems jeopardizing natural environment; increasing availability of transuranic radioisotopes; potential availability of separated fission-product radioisotopes. The following subjects are described: radioisotope tracers for the study on environmental pollution, monitoring of the environment, application of transuranium radioisotopes, such as ^{252}Cf and ^{238}Pu, FP heat and radiation sources, such as ^{90}Sr and ^{137}Cs, radiation processing, and food irradiation. (JA)

24814 NEW TRENDS IN ISOTOPE APPLICATION TECHNIQUES IN FRANCE. Fisher, C.; Sauvagnac, R. (CEA, Paris). Proc. Jap. Conf. Radioisotop.; No. 10, 23-28(Apr 1972).

From Tenth conference on radioisotopes; Tokyo, Japan (16 Nov 1971).

Utilization of radioisotopes in France is proceeding at an ever-increasing rate; a rise of about 30% over the preceding year. Sales of radioisotopes in France in 1970 were $2.6 million, of which $1.2 million was for medical use and $1.3 million was for research and industrial uses. The utilization of radiation and the recent trend leading to wider application in the future are described in the following areas: medicine, therapy, in-vivo and in-vitro diagnosis, industries using tracers in siltation and hydrology, chemical engineering, various gages, and radiosterilization, radiochemistry, and food irradiation. (JA)

24815 INDUSTRIAL APPLICATION OF RADIOISOTOPES IN KOREA. Yook, C. C. (Hanyang Univ., Seoul). Proc. Jap. Conf. Radioisotop.; No. 10, 29-54(Apr 1972).

From Tenth conference on radioisotopes; Tokyo, Japan (16 Nov 1971).

Industrial use of radioisotopes in Korea is reported for six applications. Major research on the industrial application of radioisotopes is represented by thickness gages using $\beta - \gamma$ radiation sources. Wood–plastic composites and concrete–polymer composites have also been prepared in the laboratory by using ^{60}Co. Feasibility studies on the elimination of static electricity, which is usually caused by friction between insulators and rollers in the manufacturing processes of textile, paper, and printing factories, were carried out. An attempt was made to measure wear rate of piston rings by activating them with deuterons and neutrons. A field investigation of underground water was carried out by the measurement of natural radioactivity. Detection was performed by the use of daughter disintegration of the ^{226}R series. A nondestructive test was applied in industrial mills and plants by means of radiography with x rays, ^{60}Co, ^{192}Ir, etc. However, codes and standards for radiography are not yet established in Korea. (JA)

24816 RECENT DEVELOPMENTS IN FRANCE ON THE USE OF ^{137}Cs FOR GAMMA IRRADIATION AND IN ISOTOPIC GENERATORS. Fisher, C.; Eymery, R.; Berger, R.; Boutaine, J. L. (CEA, Paris). Proc. Jap. Conf. Radioisotop.; No. 10, 145-148 (Apr 1972).

From Tenth conference on radioisotopes; Tokyo, Japan (16 Nov 1971).

The ELAN II/B facility of CEA was put in operation at the end of 1970, and has now separated several hundreds of kilocuries of ^{137}Cs. Since ^{137}Cs has a longer life than ^{60}Co and because of its ease in shielding, there may be some economic advantages in using ^{137}Cs sources. Cs will be chosen only if the price per curie is the same for both nuclides. This situation can be important in mobile irradiators, small-scale irradiators particularly in remote countries, and portable laboratory irradiators. A program for studying isotopic generators was started in different divisions of the CEA. Cooperation was initiated with several industrial

companies in order to build these systems and to promote their use. Isotopic generators can be used in various fields, for example cardiac pacemakers in medicine, navigation buoys, ocean bottom beacons, and automatic weather stations in oceanology and meteorology, underwater prospecting and exploitation, telecommunication such as radio networks in remote countries and data transmission from the automatic stations, and thermodynamic power generation. (JA)

24817 EVALUATION OF TRITIATED SCANDIUM FOR THE ELECTRON CAPTURE DETECTOR. Hartmann, C. H. (Varian Associates, Walnut Creek, CA). Anal. Chem.; 45: No. 4, 733-739(Apr 1973).

A new high temperature tritiated source utilizing a scandium substrate was evaluated. From a comprehensive ^{3}H emanation study, the maximum operating temperature has been set at 325°C. Extensive field evaluation in a pesticide residue laboratory has shown a significant improvement in electron capture detector performance. The source contamination problem has been greatly reduced. The detectivity to pesticides has been demonstrated to be greater by a factor of three than the standard titanium tritide source. (auth)

24818 MODIFIED WEDGE-FILTER WITH AN AIR-GAP FOR HIGH ENERGY RADIATIONS. Abd-Elazim Elsayed, A. (Univ. of Cairo). Isotope Radiat. Res.; 5: 5-11(Jun 1972).

A study was made to compare the efficiency of two 45°-wedge filters, a conventional one designed with its toe just at the projection of the field edge, and a modified one with its toe displaced from the geometrical edge of the field leaving an air-gap width = 12.5 mm. The profile of the modified filter was fitted—for lead material—to a parabolic function of the form: $Y = (0.391 \pm 0.002) + (0.219 \pm 0.001) X - (0.026 \pm 0.002) X^2$. The isodose distributions obtained at various field factors between 0.48 and 1.01 showed that the modified filter was more efficient than the conventional one. The filter was studied for use in radiotherapy using radioisotope sources. (auth)

24819 APPLICATION OF RADIOISOTOPES FOR THE ELIMINATION OF STATIC ELECTRICITY IN THE TEXTILE INDUSTRY. Part 2. Luenenschloss, J.; Hess, V. (Technische Hochschule, Aachen). Melliand Textilber.; 53: No. 11, 1204-1210(1972). (In German).

Suitable α^- and β-sources as ionization sources are briefly discussed and various types of ionization sources (ionotron, alphatron, isotron, Shirley Radioactive Static Eliminator-RASE, and a Th-ion blower) are described. A comparison of radioactive and electric ionizers indicates that radioactive ones can be employed economically only for the elimination of charges in very small spaces and at well-defined charge positions. (GF)

24820 INDUSTRIAL USE OF ISOTOPES IN AUSTRIA (RESULTS OF SEIBERSDORF RESEARCH CENTRE). Frevert, F. (Reactor Center, Seibersdorf, Austria). Izotoptechnika; 16: No. 2, 64-78(Feb 1973). (In Hungarian).

Topics include the production of Ge(Li) semiconductor detectors; prompt neutron activation analysis: components identification; thickness gauging and control; development of the CAMAC system; moisture and level measurements; x-ray fluorescence analysis; determination of surface weight; and tracer investigations. (auth)

Design and Fabrication

24821 EFFECT OF THE THICKNESS OF SOURCE BACKING ON THE MEASUREMENT OF β SPECTRA. Stroemich, A.; Ostertag, H.; Gonsior, B. (Inst. of Nuclear Physics, Kiel). Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 10, 2239-2244(Oct 1972). (In Russian).

The backscattering of electrons from a source backing of Al foil and its effect on the β spectra were analyzed. A double-lens spectrometer with an intermediate image was employed; the source used was ^{204}Tl. (tr-auth)

24822 PRESENT STATUS OF THE JAERI RADIOISOTOPE CENTER. Yamasaki, Fumio (Japan Atomic Energy Research Inst., Tokyo). Proc. Jap. Conf. Radioisotop.; No. 10, 99-101 (Apr 1972). (In Japanese).

From Tenth conference on radioisotopes; Tokyo Japan (16 Nov 1971).

The background and development of the Radioisotope Center at the JAERI are described. The Center's activities consist of training radiation personnel, producing radioisotopes, and research on and development of methods for producing and using radioisotopes. At present the Center produces 30 nuclides, four ^{14}C-labeled compounds, and three radioisotope radiation sources. In addition to routine studies on the production of radioisotopes, the preparation of large ^{60}Co sources, and the separation of useful fission products from liquid waste from fuel reprocessing are being studied. All wastes from radioisotope uses in Japan are also collected and treated at the JAERI. (JA)

Industrial Uses

Refer also to abstracts 24681, 24861, and 24877.

24823 (BNL-50348) CONCRETE-POLYMER MATERIALS FOR HIGHWAY APPLICATIONS. Progress Report No. 2. Kukacka, L. E.; Romano, A. J.; Reich, M.; Auskern, A.; Colombo, P.; Klamut, C. J.; Pike, R. G.; Steinberg, M. (Brookhaven National Lab., Upton, N. Y.; Federal Highway Administration, Washington, D. C. (USA)). Apr 1972. 169p. Dep. NTIS $3.00.

A research program to determine the properties of concrete-polymer materials and to find and develop potential highway applications is being performed by the Radiation Division of the Department of Applied Science, Brookhaven National Laboratory (BNL) and the Materials Division, Office of Research, Federal Highway Administration (FHWA). The program is sponsored by the U. S. Department of Transportation, Federal Highway Administration. The work to date has indicated that great improvements in the structural and durability properties of highway-quality concrete can be obtained by monomer impregnation and in situ polymerization by either radiation or thermal-catalytic means. Samples of conventional weight and structural-light-weight concretes containing several types of aggregates and with various water/cement ratios were prepared by the FHWA and impregnated at BNL. Tests were performed at both laboratories. Aggregates tested include two crushed limestones, one from the Stones River formation at Riverton, Virginia, and the other from the Plattsmouth member in Kansas; a quartzite gravel from White Marsh, Maryland; a crushed diorite from Chantilly, Virginia; a sized slag from Baltimore, Maryland; an expanded slate marketed under the trade name of Solite; and a sintered fly ash marketed under the trade name of Edicrete. After impregnation with methyl methacrylate (MMA) and radiation polymerization, all the materials produced high-strength (>15,000 psi) composites. These results are summarized in Table I. Comparable strengths have also been obtained with thermal-catalytically polymerized specimens. The data indicate that concretes prepared from locally available materials can be used in the production of polymer-impregnated concrete (PIC). In conjunction with this effort, encapsulation methods were evaluated following the vacuum-soak impregnation operation to determine the effectiveness in minimizing monomer drainage and evaporation losses. The choice of encapsulation method appears to depend upon the initial density of the concrete. (RCK)

24824 (NP-19628) PROBLEMS OF THE ATOMIC ENERGY COMMISSION ASSOCIATED WITH THE REGULATION OF USERS OF RADIOACTIVE MATERIALS FOR INDUSTRIAL, COMMERCIAL, MEDICAL, AND RELATED PURPOSES. (General Accounting Office, Washington, D.C. (USA)). 18 Aug 1972. 96p. GAO, Washington, DC $1.00.

The General Accounting Office (GAO) reviewed the AEC's inspection and licensing programs related to the licensing of commercial, educational, industrial, and medical users of radioactive materials and of fabricators and processors of reactor fuels in order to recommend to Congress actions needed to improve the regulation of users of radioactive materials. The scope of the GAO review is described. Past inspection and enforcement actions by the AEC are discussed. Difficulties in forcing licensees to comply with regulations are pointed out. Particular attention is paid to problems in the distribution and use of radioactive material in the practice of medicine. Specific recommendations are made including a streamlining of AEC documentation procedures so that more time can be spent on inspections. (LCL)

24825 (TID-26240) MARINE PRODUCTS DEVELOPMENT IRRADIATOR PROGRAM: DOSIMETRY AND OPERATIONS. Annual Report, October 1, 1968-June 30, 1970. Kaylor, J. D.; Gadbois, D. F.; Murphy, E. J.; Green, J. H. (National Marine Fisheries Service, Gloucester, Mass. (USA). Gloucester Fishery Products Lab.). Feb. 1973. Contract AT(49-11)-3005. 135p. Dep. NTIS.

Calibration of the Marine Products Development Irradiator was completed so that the data so obtained can form part of the future request for clearance of irradiated fish fillets. Shipments of selected irradiated seafoods were made by air and by sea from Iceland to Massachusetts to determine the extension of shelf life conferred by ionizing radiation. The varied nature and special maintenance features of the Marine Products Development Irradiator have been described. (auth)

24826 ECONOMICAL EFFICIENCY OF THE INTRODUCTION OF GAMMA RAY IRRADIATED PLANTS INTO AGRICUL-

TURAL PRACTICE. Prokof'ev, N. S. (Inst. of Economics, Moscow). Isotopenpraxis; 8: No. 5, 168-170(May 1972). (In German).

Gamma radiation installations are discussed from technical as well as from economical viewpoints with respect to agriculture. Radiation of seed potatoes before planting, and of harvested potatoes before storage frequently repays the cost of the installation within one season. At the present time, pesticidal doses for grains can be achieved economically only with particle accelerators; gamma sources are too expensive. The USSR plans two experimental radiation installations for the treatment of fish. Particularly promising is the use of gamma radiation for the sterilization of material in veterinary medicine and for the treatment of wool and leather raw material. Radiation use in the treatment of new plants and microorganisms is also mentioned. (HBG)

24827 USE OF NUCLEAR TECHNIQUES IN FOOD AND AGRICULTURE. Fried, M. (International Atomic Energy Agency, Vienna). Proc. Jap. Conf. Radioisotop.; No. 10, 69-75 (Apr 1972).

From Tenth conference on radioisotopes; Tokyo, Japan (16 Nov 1971).

Nuclear techniques (isotopes and radiation) reach their ultimate in peaceful application when they are used for agriculture to help feed the hungry world. This task is coordinated on the international level by the Joint FAO/IAEA Division of Atomic Energy in Food and Agriculture. Examples are presented of the use of the isotopes and radiation for the solution of practical problems in food and agriculture. Six areas of the application are touched upon, i.e., soil fertility, mutation breeding, entomology, animal production and health, pesticide residues and pollution, and food preservation. As for the soil fertility, in order to use nitrogen fertilizer efficiently, utilization and loss of ^{15}N-labeled fertilizer were determined. By irradiation, 95 mutant varieties of cereals, vegetables, ornamentals, etc., were induced by 1970. In entomology, radiation is used for sterilizing harmful insects. In animal production, labeled compounds were applied to study metabolism and kinetics of minerals, and gamma irradiation was used on parasite vaccines. As for the pesticide residues and pollution, development of a radiotracer technique made it possible to investigate the movement of labeled pesticides. For food preservation, radiation is useful to destroy organisms such as bacteria, molds, and insects that spoil human foods and to prevent sprouting of vegetables such as potatoes and onions. (JA)

24828 PRESENT STATUS AND PROBLEMS OF RADIATION EQUIPMENT INDUSTRIES IN JAPAN. Majima, Tetchu (Japan Radiation and Medical Electronics, Inc.; (Tokyo). Proc. Jap. Conf. Radioisotop.; No. 10, 105-111(Apr 1972). (In Japanese).

From Tenth conference on radioisotopes; Tokyo, Japan (16 Nov 1971).

In recent years, increasingly diverse uses of radioisotopes and radiation have been developed, and instruments and facilities concerned with these uses have been developed. The present state of production of radiation instruments, facilities, etc., in Japan is described for the following matters: current status of the radiation equipment industries; various machinery and equipment still under development, utilization of detectors, analyzers, monitors, industrial equipment, medical facilities, etc., and measures necessary for the promotion of radiation utilization and development including information servies, etc. (JA)

24829 RECENT TRENDS OF INDUSTRIAL APPLICATIONS OF RADIOISOTOPES AND RADIATION TECHNOLOGY. Yuan, H. C. (International Atomic Energy Agency, Vienna). Proc. Jap. Conf. Radioisotop.; No. 10, 196-202(Apr 1972).

From Tenth conference on radioisotopes; Tokyo, Japan (16 Nov 1971).

Recent developments in the use of radiation techniques in chemical processing and the use of nuclear techniques in the investigation of environmental pollution problems are reviewed. It is envisaged that composite materials, electron-beam processing, and the design of reactor systems reflect the current interest in the area of radiation processing. In environmental problems the contributions of various nuclear techniques in the analysis of trace amounts of pollutants and the use of radioactive tracers for following the movement of pollutants have opened a very promising area for radioisotope applications. (auth)

24830 USE OF FISSION PRODUCTS AS RADIATION SOURCES. Ohtsuka, Norikatsu (Japan Atomic Energy Research Inst., Takasaki). Proc. Jap. Conf. Radioisotop.; No. 10, 244-246(Apr 1972). (In Japanese).

From Tenth conference on radioisotopes; Tokyo, Japan (16 Nov 1971).

A large number of fission products are produced in considerable amounts in nuclear reactors, but those useful as radiation sources are relatively few. In the world, including Japan, utilization of fission products for irradiation has increased in recent years in radiation chemistry, food preservation, sterilization of medical supplies, etc. Developments in this field are described for ^{137}Cs, spent fuel, ^{90}Sr, ^{147}Pm, and ^{85}Kr. As a gamma source, ^{60}Co is most widely used at present, but in France and the U. S. in particular, commercial irradiation facilities using ^{137}Cs are being placed on the market. The spent fuel, while having its unavoidable drawbacks, has advantages at the same time, e.g., low cost and high radiation intensity. ^{90}Sr as an electron-beam source has high energy-efficiency and simple shielding; it is used both as external and internal sources. ^{85}Kr is the only useful gaseous fission product; being inactive chemically, it is used in radiation chemistry. (JA)

LIFE SCIENCES

Radiation Effects on Biochemicals

24831 (CEA-CONF-2160) NEUTRON ACTIVATION ANALYSIS BY THE MONOSTANDARD METHOD: APPLICATION TO THE STUDY OF ANCIENT CERAMICS. Delcroix, G.; Philippot, J. Cl. (Centre National de la Recherche Scientifique, Paris (France). Centre de Recherches Archeologiques; Commissariat a l'Energie Atomique, Orsay (France)). 1972. 21p. (CONF-720920-4). Dep. NTIS (U.S. Sales Only).

From 2nd international conference on forensic activation analysis; Glasgow, UK (27 Sep 1972).

Thirty-one elements were determined in five samples of medieval pottery. Neutron irradiations were performed at the Laboratory Pierre Sue at Saclay. A 33 minute irradiation was followed by five measurements: 2, 5, 15, 43, and 60 days. Gamma spectroscopy was performed at ORSAY, with Ge detectors, the resolutions of which varied from 1.5 to 3 keV in the energy range 0 to 3 MeV. (auth)

24832 (FRNC-TH-301) THEORY OF SYSTEMS AND APPLICATIONS OF THE EFFECTS OF RADIATIONS ON CHEMICAL AND BIOLOGICAL SYSTEMS. Delattre, P. (Toulouse Univ. (France)). 1972. 214p. (In French). Dep. NTIS (U.S. Sales Only) $12.75.

Thesis.

The basis of the system transformation theory (topological and order properties, concepts concerning the structure and the model) is given; the basis of a theory applicable to molecular systems subjected to irradiation is then given: axioms and development equations (remarks on catalysis phenomena and decomposition into diagrams); properties of systems relevant to the linear formalism and the axioms chosen (changes occurring during and after irradiation-transitory regimes; effects of the characteristics of the radiation used, the composition of the system, and the type of irradiation on the curve representing equivalent classes, and the series of diagrams corresponding to the formation of different class elements). The application of this theory to studies of the fundamentals of dosimetry are given together with the theoretical models used in radiobiology and radiotherapy. The establishment of reaction schemes in radiation chemistry is also discussed. (France)

24833 PHOTOPRODUCT FORMATION IN U.V.-IRRADIATED DNA AT HIGH TEMPERATURES AND HIGH IRRADIATION DOSES. Kramer, J.; Riklis, E. (Israel Atomic Energy Commission, Beersheba). Int. J. Radiat. Biol.; 23: No. 1, 75-81(Jan 1973).

DNA was irradiated with high uv doses, in the order of 10^6 to 10^7 ergs/mm^2 (in minutes of irradiation) at temperatures up to 85°C. Two different photoproducts obtained after hydrolysis could not be separated chromatographically in solvent system I (butanol : acetic acid : water (80 : 12 : 30)), but could be separated in solvent system II (ethyl acetate : formic acid : water (7 : 2 : 1)). From the chromatographic properties and other chemical and spectral evidence, it seemed that the photoproducts are identical to uracil and urea derived from the thymine of DNA. Photoproduct formation was dependent on dose and temperature. Similar results were obtained when photosensitized pre-irradiated DNA was re-irradiated with uv in the same manner as native DNA, implying that the new photoproducts are not formed via the thymine dimer. (auth)

24834 COMPARATIVE EFFECTS OF ELECTRON AND NEUTRON IRRADIATION ON THE RELEASE OF ENZYMES FROM ISOLATED RAT-SPLEEN LYSOSOMES. Watkins, D. K.; Deacon, S. (Hammersmith Hospital, London). Int. J. Radiat. Biol.; 23: No. 1, 41-50(Jan 1973).

The effects of irradiation by electrons and cyclotron neutrons (7 MeV) were compared in a membrane system consisting of isolated rat-spleen lysosomes in suspension. For irradiation in air, the RBE's for the release of four out of the five enzymes investigated were less than one. When lysosomes were irradiated under nitrogen, at all doses up to 100 krads, neutrons were found to be substantially more effective than electrons. Values of OER for neutrons (~2.5) were greater than those commonly observed for mammalian cell death. The results are discussed in the light of certain models for radiation damage to cells. A novel irradiation vessel is described. (auth)

24835 FLASH PHOTOLYSIS OF RIBONUCLEASE A. Volkert, W. A.; Grossweiner, L. I. (Illinois Inst. of Tech., Chicago). Photochem. Photobiol.; 17: No. 2, 81-90(Feb 1973).

Flash photolysis spectra showed that ultraviolet irradiation of RNase ($\lambda > 250$nm) at pH 11.5 generated the hydrated electron and a long-lived transient with absorption maxima at 390 nm and 410 nm, attributed to the phenoxyl type radical from tyrosyl residues. Comparison of the initial yields with flash photolysis spectra obtained from aqueous tyrosine and mixtures of the chromophoric amino acids indicated that 3 to 4 tyrosyl residues were photoionized in the primary act. This process was almost completely quenched at pH 1 to 9, even though the p-alanylphenoxyl radical was obtained with tyrosine over this pH range and the accompanying electron was observed at pH 7. The negative result was not altered by denaturation of RNase with 8 M urea or heating to 70°C, suggesting that a primary chain interaction was responsible for the suppression of tyrosyl residue photolysis. This mechanism was supported by flash photolysis spectra of small neptides, showing that the initial radical yield from tyrosylglycylglycine was strongly quenched compared with tyrosine when the phenolic group was protonated. Comparison with published results on fluorescence and inactivation quantum yields indicated that photochemical electron ejection from RNase in alkaline solutions takes place in the dissociable residues and does not contribute to loss of enzymic activity. (auth)

24836 BACTERIOCIN FACTORS RESPONSIBLE FOR UV-SENSITIVITY AND SUSCEPTIBILITY TO POST-IRRADIATION BREAKDOWN OF DNA. Alper, T.; Forage, A. J.; Afzal, L. Mol. Gen. Genet.; 119: No. 4, 367-371(1972).

Lack of dose-modifying protection by acriflavine against uv killing of E. coli Bs-2 and Bs-11 is explained by their carrying an inducible colicin. Its induction could account for post-irradiation break-down of DNA. (auth)

24837 DNA REPAIR SYNTHESIS AFTER X-IRRADIATION IN E. COLI. David, C. B.; Kremer, W. B.; Huang, A. T.; Fluke, D. J. (Duke Univ., Durham, NC). Experientia; 28: No. 12, 1499-1502(15 Dec 1972).

DNA-polymerase-deficient mutants and radioresistant B/r mutants of Escherichia coli were exposed to ultraviolet and x radiation and observations were made on molecular weights and sedimentation patterns of DNA. Results indicated that DNA repair synthesis is a necessary step in the closure of strand breaks caused by x radiation, but that it involves much shorter segments of DNA than in uv excisional repair. (HLW)

24838 EFFECT OF CYCLIC AMP ON THE PRODUCTION OF SINGLE-STRAND BREAKS IN DNA OF X-IRRADIATED E. COLI B/r. Lehnert, S. (Sloan-Kettering Inst. for Cancer Research, New York). Int. J. Radiat. Biol.; 23: No. 1, 11-21(Jan 1973).

Cyclic AMP, present during irradiation or added subsequently, increased the number of single-strand breaks produced by x-irradiation in the DNA of E. coli B/r CSH. This effect of cyclic AMP was not observed when the cell membrane was modified by treatment with 0.2 mM EDTA, when dinitrophenol is present in the medium, or when stationary-phase rather than log-phase cells are irradiated. It is postulated that cyclic AMP activates a membrane-bound nuclease, which degrades irradiated DNA. (auth)

24839 INDUCTION OF PYRIMIDINE DIMERS IN BACTERIAL DNA BY 365 NM RADIATION. Tyrrell, R. M. (Argonne National Lab., IL). J. Mater. Sci.; 7: No. 12, 69-73(Dec 1972).

Dose-response curves are presented demonstrating a significant and dose dependent induction of thymine-containing pyrimidine dimers in Escherichia coli B/r hcr and E. coli B phr by radiation of 254 nm (over a range of 0 to 1000 ergs mm^{-2} and 365 nm over a range of 0 to 4 ergs mm$^{-2} \times 10^{-6}$). Irradiations were carried out at 0°C. A dose-response curve for E. coli B phr (a photoreactivationless strain) indicated that photo-enzymatic repair did not significantly affect dimer yield. The role of pyrimidine dimers in lethality at 365 is discussed with reference to computations of dimer yield and to biological inactivation of E. coli B/r hcr at 254 nm and 365 nm. (UK)

24840 IRRADIATED COBRA (NAJA NAJA PHILIPPINENSIS) VENOM. Salafranca, E. S. (Serum and Vaccine Labs., Rizal, Philippines). Int. J. Appl. Radiat. Isotop.; 24: No. 1, 60(Jan 1973).

One percent cobra (Naja naja philippinensis) venom solution, in physiological saline prepared from a large pool of dried venom, was sterilized by filtration and irradiated with ^{60}Co in varying doses. Results of LD_{50} titrations and Oudins test read after 7 days indicated that irradiation doses of ¼ Mrad, ½ Mrad, and 1 Mrad reduced toxicity to 83, 66, and 43% of the nonirradiated control, respectively, while the antigenic component remained practically unchanged. Formol toxoided venom included in the tests for comparison was shown to have lost at least 60% of the original antigenic component when its toxicity was reduced to about 0.1% that of the original material. Results of immunization of rabbits with venom irradiated with 1 Mrad are given. (UK)

24841 ENDONUCLEASE ACTIVITY TOWARD DNA IRRADIATED IN VITRO BY GAMMA RAYS. Setlow, R. B.; Carrier, W. L. (Oak Ridge National Lab., TN). Nature (London) New Biol.; 241: No. 110, 170-172(7 Feb 1973).

A study was made of the ability of an endonuclease extract from Micrococcus luteus to make single strand nicks in previously γ-irradiated Escherichia coli DNA. Sedimentation patterns of DNA in alkaline sucrose indicated that Micrococcus luteus extract had no activity towards unirradiated DNA. After anoxic irradiation with 20 Krad, there were many single-strand breaks in the DNA and if such DNAs were treated with extract, there was a further large decrease in molecular weight. Results of experiments with denatured DNA indicated that the changes in molecular weight arose from chain breaks rather than alkali-labile bonds made by the extract. With DNAs irradiated in air, endonuclease-sensitive sites were detectable, but there were fewer sites per chain break than for DNAs irradiated anoxically. The endonuclease-sensitive sites obtained in γ-irradiated DNAs appeared to be lesions other than cyclobutane pyrimidine dimers. Measurements were also made of the ability of a DNA exposed to a large ultraviolet fluence to compete for the endonuclease activity towards both ultraviolet- and γ-irradiated DNAs. Significant inhibition of both activities was observed, and it is suggested that this result although indicating that the same enzyme acts on both dimers and base damage resulting from γ rays, is not conclusive because the ultraviolet-irradiated DNA contains products other than pyrimidine dimers. (UK)

24842 EFFECTS OF IONIZING RADIATION ON IN VITRO REPLICATION OF DNA BY DNA POLYMERASE I. Saffhill, R.; Weiss, J. J. (Christie Hospital and Holt Radium Inst., Manchester, Eng.). Nature (London) New Biol.; 241: No. 107, 69-71 (17 Jan 1973).

A study was made of the action of a purified DNA polymerase I fraction from Escherichia coli strain B on γ irradiated high-molecular-weight calf thymus DNA templates. A ^{137}Cs, source was used at a dose rate of 8.4 rad/sec over a range of 0 to 50 Krad. Results showed a change in the priming activity of the DNA and in the base composition of the newly synthesized DNA. It is suggested that this is due to the formation of new active and inactive binding sites on the DNA. The fractional increase in active binding sites was found to be 0.024/Krad and in inactive binding sites 0.050/Krad. The data presented are compared with the results of other workers. (UK)

24843 DISTRIBUTION OF DIMERS IN ULTRAVIOLET-IRRADIATED DNA. Brunk, C. F. (Univ. of California, Los Angeles). Nature (London) New Biol.; 241: No. 107, 74-76 (17 Jan 1973).

A study was made of the effect of adjacent bases on thymine dimer formation in uv-irradiated DNA. At a dose of 8,000 ergs/mm^2 (254 nm), there was a steady increase in the percentage of thymine dimerized as the lengths of the pyrimidine tracts increased. The percentage of thymine dimerized was more than four times greater in pyrimidine tracts 9 long than in tracts 2 long. At 40,000 ergs/mm^2, similar increases were observed, though the increase in the longest tracts were less dramatic than for the lower dose. Higher percentages of thymine were damaged by radiation at 313 nm. Investigations of the distribution of adjacent thymines in the pyrimidine tracts did not account for the preferential formation in the longer tracts. (UK)

24844 DEMONSTRATION OF DNA REPAIR IN NORMAL AND NEOPLASTIC TISSUES AFTER TREATMENT WITH PROXIMATE CHEMICAL CARCINOGENS AND ULTRAVIOLET RADIATION. Lieberman, M. W.; Forbes, P. D. (Temple Univ., Philadelphia). Nature (London) New Biol.; 241: No. 111, 199-201(14 Feb 1973).

Autoradiography of various tissues from rats, mice, Hanford-Labco miniature pigs, and rabbits, was used to demonstrate DNA repair synthesis in normal and neoplastic tissues. To induce neoplastic changes, a group of hairless mice were given a surface ultraviolet dose of 2000 J m^{-2} daily, 5 days each week for 25 weeks. Morphologically normal skin, hyperplastic skin and squamous cell carcinomas were used from these irradiated animals. For repair studies, biopsies were irradiated using uv radiation on both sides with 1.150 J m^{-2}, or incubated for 15 to 20 min with one of the following: 2mM N-acetoxy-2-acetylaminofluorene (NA-AAF); 1.4 mM beta-propiolactone (BPL); 1 mM 7-bromomethylbenz(a)-anthracene (7 BrMeBA). Repair of carcinogen- and ultraviolet-induced damage to DNA was demonstrated by non-S-phase labelling in skin, liver and kidney tissues, and in mouse skin the epithelial cells retained the ability to repair DNA as they underwent malignant change. Little or no unscheduled DNA synthesis was seen in rabbit cerebellar neurones or striated myocytes. (UK)

24845 RADIOBIOLOGICAL INVESTIGATION ON THE DEOXYRIBONUCLEIC ACID OF THE PHAGE φ-X-174. Stephan, G. Karlsruhe, Ger.; Karlsruhe Univ. (1972). 54p. (In German). Thesis.

Investigations were carried out on both the single-strand DNA isolated form phage particles and the so-called replicative forms (RFI and RFII) that were irradiated with a ^{60}Co gamma source. The radioinduced damage was defined in terms of inactivation of infectivity for spheroplasts of Escherichia coli and in terms of the single-strand breaks induced in the replicative DNA, taking into account that the so-called RFI will change quantitatively into RFII after a radioinduced break. The two forms can be identified by their different sedimentation behavior. The radioprotective effect of cysteamine was studied along with the above effects. The infection kinetics of unirradiated RF show a linear dependence over a wide range of the DNA concentration. With the exception of one case, namely the irradiation of RFI-DNA, the dose-dependent inactivation was found to follow a simple exponential relation. Neither after irradiation in presence of, nor in absence of, cysteamine could a host-cell reactivation of radioinduced injuries be stated in the isolated single-strand DNA, whereas about 20 to 37% of the radio-induced damage in the double-strand RF were found to be eliminated by host-cell reactivation. This effect is significantly reduced after cysteamine treatment. For the first time the fractionation of DNA in the saccharose gradient was applied to achieve a disintegration of the irradiated RFI to distinguish between damaged RFI and radioinduced RFII so that the different radioinduced injuries could be analyzed separately. Thus is could be demonstrated that the so-called damaged RFI is not damaged in the actual sense as only lesions were detected in its base and/or sugar molecules, but no breaks. In contrast to this, the radioinduced damage in RFII was determined to consist of one or to several single-strand breaks in combination with changes of the molecular components of the DNA. The conclusions to be drawn from these investigations are discussed in detail. (GF)

24846 PROTECTIVE ACTION OF DITHIOTHREITOL DURING THE γ IRRADIATION OF NITROGENASE. Linde, V. R.; Uzenskaya, A. M.; Kochetkov, V. V. (Inst. of Chemical Physics, Moscow). Izv. Akad. Nauk SSSR, Ser. Khim.; No. 1, 100-104(Jan 1973). (In Russian).

Cells of Azotobacter vinelandii were used as a source of nitrogenase, and the kinetics of nitrogen fixation by preparations of nitrogenase after exposure to various doses of ^{60}Co radiation were studied. Dithiothreitol possessed protective action for nitrogenase against such radiation in doses of 20 to 1500 kR. Irradiation of nitrogenase with increasing doses of γ radiation produced decreasing levels of the concentration of SH-groups. (KSW)

Radiation Effects on Cells

24847 (BNL-17547) ENDPOINTS AND TARGETS IN RADIOBIOLOGY. Elkind, M. M. (Brookhaven National Lab., Upton, N. Y.). 1972. 12p. (CONF-721001-2). Dep. NTIS.

From Conference on physical mechanisms in radiation biology; Airlie, Virginia, USA (11 Oct 1972).

A discussion is presented of cell killing, mutagenesis, carcinogenesis, and teratogenesis as the principal end effects of radiation. Advantages of studies on microorganisms and mammalian cells are discussed. The importance of the nucleus as a target in radioinduced cell killing is emphasized and DNA-related targets are discussed with regard to sensitizing effects of actinomycin D, relation of dose to radiation damage, sedimentation of DNA from irradiated mammalian cells, enzymatic repair of radioinduced strand breaks, and relationship between damage to DNA-lipid complex and cell killing. (HLW)

24848 (EUR-4918) MOLECULAR TARGET THEORY OF CELL SURVIVAL AND ITS APPLICATION IN RADIOBIOLOGY. Chadwick, K. H.; Leenhouts, H. P. (Instituut voor Toepassing van Atoomenergie in de Landbouw, Wageningen (Netherlands)). Mar 1973. 57p. Dep. NTIS (U. S. Sales Only) $5.00.

This report is divided into three sections. The first section is concerned with the presentation of a theory for survival of cultured human cells following irradiation, which is based on the radiation-induced damage to a double molecular target, the double strand break in the DNA double helix. The theoretical expression for cell survival is fitted to experimental results, and the implications of the theory with respect to RBE, LET, the oxygen effect, and radiological protection are considered briefly. The second section deals with the effect of protracted exposure on cell survival, and it is shown that the theoretical expectations are borne out in the analysis of experimental results. The effect of low dose rate exposure on cell survival is explained on the basis of the repair of broken DNA single strands. The third section considers the variation of radiation sensitivity with position of the cell in the cell cycle. It is shown that the theory gives a good fit of the survival curve shape in all parts of the cell cycle and that the two coefficients used in the theory have a consistent variation through the cycle for different types of cells. The variations of the coefficients give strong evidence in favor of the assumption that the double molecular target is the DNA double helix and that the possibility for the repair of DNA single strand breaks varies through the cell cycle. (CH)

24849 (LF-45, pp 222-225) RESPONSE OF CANINE LYMPHOCYTES TO MITOGENIC STIMULATION IN VITRO. Benjamin, S. A.; Jones, R. K. Nov 1972.

In fission product inhalation program.

Peripheral lymphopenia has been observed in dogs that inhaled relatively insoluble forms of radionuclides. It has been postulated that this phenomenon is due to direct exposure to circulating lymphocytes as they pass through the lung. Studies have been undertaken in order to establish whether one lymphoid cell population is selectively affected. Relative responses of thymus dependent and bursa dependent lymphocytes from canine peripheral blood have been evaluated by in vitro culture and stimulation with phytohemagglutinin and pokeweed mitogen. Results have been variable both between different dogs and within a single dog sampled on different days, although significant stimulation of canine lymphocytes with both compounds has been consistently observed. (auth)

24850 RADIATION RESPONSE OF A LONG-TERM CULTURE OF HUMAN LYMPHOID CELLS. 2. Synchronized populations. Drewinko, B.; Humphrey, R. M. (Anderson Hospital and Tumor Inst., Houston, TX). Int. J. Radiat. Biol.; 23: No. 1, 1-9(Jan 1973).

Populations of human lymphoid cells in culture (T_1 cells) were synchronized by thymidine block and mitotic selection. The synchronized cells were exposed to x radiation at various stages of the cell-cycle and the survival was determined in terms of colony-forming ability. T_1 cells showed age-dependent radiosensitivity similar to other mammalian cells in culture: relative radiosensitivity in G_1, relative radioresistance in S, and intermediate radiosensitivity in G_2. The changes in response are reflected in the dose-response curves by variations in the capacity to absorb damage, as expressed by the width of the shoulder (D_q of 180 rads in G_1, to D_q of 365 rads in S), while the slope remained essentially unchanged. (auth)

24851 CONCENTRATIONS OF INOCULATED CELLS AND SHAPES OF SURVIVAL CURVES. Masuda, K.; Wakisaka, S. (Kyushu Univ., Fukuoka). Int. J. Radiat. Biol.; 23: No. 1, 99-103(Jan 1973).

A study was made of the causes of differences in x-radiation dose-response curves between S3 and L5 strains of HeLa cells. An attempt was made to demonstrate the effects of differences in concentration of plated L5 cells on the dose-response curve at 830, 925, and 1015 rads. The surviving fraction of L5 cells to a given dose was independent of cell concentration when the number of plated cells was less than 10^4/dish, but decreased with an increase in cell number beyond 10^4/dish. When the number of plated cells exposed to 1015 rads was increased from 10^4 to 10^6/dish, there was a 100-fold decrease in the observed surviving fraction. The surviving fraction of S3 cells, after 485 and 1110 rads, was not affected appreciably by increasing the number of cells inoculated after 485 and 1110 rads, from 3×10^4 to 10^5, and from 2×10^4 to 5×10^5 per dish. Similar increases in L5 cells produced an apparent decrease in the surviving fraction. Replacement of the growth medium produced a 1.2-fold increase in the surviving fraction of L5 cells exposed to 830 rads of x rays, but the dependence of the surviving fraction on the concentration of inoculated cells was not affected by this procedure. It is suggested that there is only one type of dose-response curve, using the reproductive capacity of cells as an index, differences being attributable to differences in the post-irradiation conditions of the cells. (UK)

24852 SHORT-TERM EFFECTS OF IONIZING RADIATION ON VOLUME-REGULATION OF MURINE LYMPHOMA CELLS IN VITRO. Evidence for the involvement of hydrogen peroxide. Rosenberg, H. M.; Mathews, E. (Case Western Reserve Univ., Cleveland). Int. J. Radiat. Biol.; 23: No. 1, 91-94(Jan 1973).

When nucleated mammalian cells are subjected suddenly to hypotonic medium, they increase rapidly in volume, shrinking back to their original volume within 30 min at 37.5°C. The shrinking phase could be accounted for by loss of intracellular potassium (plus co-ions), coupled with loss of water down the resulting osmotic gradient. If active outward transport of sodium is inhibited, the cells do not shrink back, and although losing potassium ions, they have a greatly elevated sodium content after 30 to 40 min in hypotonic medium. Inhibition of this shrinking phase was used to assay for γ-radiation-induced damage to the plasma membrane in murine lymphoma cells. No inhibition was observed below 30KR. After 30KR, the cells were slower to return to their original volume, whereas after 80KR, the cells only partially returned in observation periods of up to 70 min. Unirradiated cells were inhibited from shrinking if they were initially suspended in irradiated medium (80KR), or in medium to which H_2O_2(1×10^{-6} gm/ml) had been added. No such inhibition was observed if, before the cells were added, the treated media were incubated with 2×10^{-2} mg/ml catalase. Cells were irradiated (80KR) while suspended in medium + catalase, or heat-inactivated catalase. If these cells were incubated (37.5°C) for 25 min or 1 hr after irradiation, only cells irradiated in the presence of inactivated catalase were larger (60 to 80%) than their initial volume 1 hr after water was added. These results are compared with previous studies and those of other workers, particularly with erythrocyte experiments. (UK)

24853 PLATEAU PHASE IN GROWTH INDUCED BY HYPOXIA. Koch, C. J.; Kruuv, J.; Frey, H. E.; Snyder, R. A. (Univ. of Waterloo, Ont.). Int. J. Radiat. Biol.; 23: No. 1, 67-74(Jan 1973).

Mammalian fibroblasts were incubated for four days at 37°C under hypoxic conditions. After one day the cells reached a plateau-phase in growth. After replating under aerobic conditions, various properties of the cells were investigated. It was found that they had accumulated in a pre-DNA-synthetic state. However, growth curves, DNA-synthesis data, and γ radiation-survival curves over a dose range 0 to 1750 rads indicated that these cells behaved like an asynchronous population. (auth)

24854 POST-REPLICATION REPAIR OF DNA IN ULTRAVIOLET IRRADIATED MAMMALIAN CELLS. NO GAPS IN DNA SYNTHESIZED LATE AFTER ULTRAVIOLET IRRADIATION. Lehmann, A. R. (Univ. of Sussex, Eng.). Eur. J. Biochem.; 31: No. 3, 438-445(Dec 1972).

Ultraviolet light produces pyrimidine dimers in cellular DNA. In mouse cell lines, the great majority of these pyrimidine dimers are not excised, but remain in high-molecular-weight DNA. Hence the DNA used as template for DNA synthesis in the first generation after uv irradiation must contain such dimers. In two mouse cell lines (L5178Y and 3T3), alkaline sucrose sedimentation studies showed that the DNA pulse-labeled shortly after irradiation contained gaps, which by analogy with the situation in Escherichia coli, are presumed to be opposite the pyrimidine dimers. In contrast such gaps could not be detected in DNA pulse-labeled several hours after irradiation, despite the fact that dimers must have been present on the template strands. A possible explanation is that gaps were still being formed, but were filled in rapidly and were therefore not detected. This hypothesis was tested as follows. Either 1 or 8 h after uv irradiation, cells were pulse-labeled in the presence of theophylline. This purine inhibits the filling in of gaps presumably by binding to the DNA in the gap. Even in the presence of theophylline, the late-synthesized DNA was considerably larger than the early-synthesized DNA. This suggests that at late times after irradiation, gaps were either not formed at all opposite the dimers, or were so transient that theophylline could not bind and inhibit their filling in. A model for synthesis of DNA on templates containing pyrimidine dimers in mammalian cells, based on these findings and other recent results, is discussed. (auth)

24855 DISTRIBUTIONS OF CELL VOLUME AND DNA CONTENT OF RHABDOMYOSARCOMA CELLS GROWING IN VITRO AND IN VIVO AFTER IRRADIATION. Kal, H. B. (Toegepast Natuurwetenschappelijk Onderzoek, Rijswijk, Netherlands). Eur. J. Cancer; 9: No. 1, 77-79(Jan 1973).

Changes in cell volume distributions were measured with a Coulter counter in rat rhabdomyosarcoma cells, after acute irradiation with a dose of 2000 rads of ^{137}Cs γ rays administered in 16.4 min to R-1 cells in vitro, and a dose of 2000 rads of 300 kV x rays administered in 6 min in vivo. The mean cell volume of irradiated cells in vitro was 1.4 times the cell volume of the controls, 16 hr after irradiation. Results of in vivo experiments, 15 hr after irradiation, showed a mean cell volume of 1.04 times that of the cells from the unirradiated tumor. Parallel changes in the DNA content were measured with an impulse-cytophotome-

ter and it was concluded that the irradiated proliferating R-1 cells were accumulated or blocked in the G_2 phase and the non-proliferative cells were arrested in the G_1 phase. There were indications that the proliferating cells in the tumor were affected in a similar way by irradiation as cells cultured in vitro. (UK)

24856 REPAIR OF DNA DAMAGE IN ULTRAVIOLET-SENSITIVE CELLS ISOLATED FROM HeLa S3 CELLS. Isomura, K.; Nikaido, O.; Horikawa, M.; Sugahara, T. (Kanazawa Univ., Japan). Radiat. Res.; 53: No. 1, 143-152(Jan 1973).

Two ultraviolet-sensitive cell lines, designated S-1M and S-2M, were isolated from the original HeLa S3 cells by the N-methyl-N'-nitro-N-nitrosoguanidine (MNNG)-ultraviolet light (UV) and and 5-bromodeoxyuridine (BUdR)-visible light method. The D_0 values were 87, 68, and 45 ergs/mm^2, and the extrapolation numbers (n) were 1.4, 1.0, and 1.0 for HeLa S3, S-1M, and S-2M cells, respectively. The average initial excision rate of UV-induced thymine dimers in the UV-sensitive cells is approximately one-fifth that in HeLa S3 cells. The UV-sensitive cells may appear in the original HeLa S3 population due to the mutagenic action of MNNG. S-2M cells are more sensitive to the carcinogen 4-nitroquinoline 1-oxide (4-NQO) than HeLa S3 cells. However, there are no significant differences in sensitivity to x-irradiation among the three cell lines. The findings indicate that the 4-NQO-induced DNA damage and its repair are similar to that found after UV-irradiation, but different from that found after x-irradiation. (auth)

24857 USE OF THE MITOTIC SELECTION PROCEDURE FOR CELL CYCLE ANALYSIS. Comparison Between the X Ray and Cycloheximide G2 Markers. Schneiderman, M. H.; Dewey, W. C.; Leeper, D. B.; Nagasawa, H. (Colorado State Univ., Fort Collins). Exp. Cell Res.; 74: No. 2, 430-438(Oct 1972).

Mechanical selection of mitotic Chinese hamster ovary (CHO) cells from asynchronous monolayer cultures was used to locate the last point in the cell cycle at which x-radiation (150 or 300 rads) or cycloheximide (CHM at 5 μg/ml) acts to prevent cells from progressing into mitosis, i.e., the x-ray and CHM markers. This method, which precisely compared the location of the markers indicated that the x-ray and CHM markers were different, i.e., 49 ± 4 min and 67 ± 5 min before the completion of division, respectively. This difference may be due to the time required for CHM to inhibit the synthesis of particular proteins necessary for division, although 5 μg/ml of CHM did reduce the rate of protein synthesis by 90% within about 5 min. As irradiated cells recovered from their division delay, they divided at a rate faster than the controls. This parasynchronous growth resulted because older cells were accompanied by younger cells due to the fact that division delay increased as cells were irradiated later in the cycle. (auth)

24858 EFFECT OF X RAYS ON SOME CYTOCHEMICAL PROPERTIES OF MACROPHAGES AND CARCINOMA CELLS SURFACE. Vorbrodt, A.; Grabska, A.; Gruca, S.; Krzyzowska-Gruca, S. (Inst. of Oncology, Gliwice, Poland). Acta Histochem.; 44: No. 1, 29-40(1972).

The effect of x rays (1300 R) on some cytochemical properties of cell surface of mouse peritoneal macrophages and Ehrlich-Landschütz diploid (ELD) carcinoma cells cocultivated in vitro was studied. It was found that untreated and x-ray-treated macrophages have a prominent cell coat demonstrated by concanavalin A-peroxidase-diaminebenzidine (CAPD) method, and show relatively strong reaction for ATP-ase in cell membrane. On the contrary, the ELD cells show slight reaction for the ATP-ase in cell membrane which becomes weakened or completely negative 3 to 5 days after irradiation. The cell coat of x-irradiated ELD cells becomes thinner and in numerous cells disappears. These observations suggest that x rays act as an altering factor of carcinoma cells coat and in this way promote the phagocitosis of these cells by macrophages. (auth)

24859 FREQUENCY AND TYPES OF CHROMOSOME ABERRATIONS IN LEUKOCYTES OF CIRCULATING HUMAN BLOOD IRRADIATED IN VITRO DEPENDING ON DIFFERENT DOSES OF IRRADIATION. Borodkin, P. A. (Inst. of Biology, Syktyvkar, USSR). Genetika; 9: No. 1, 171-173(Jan 1973). (In Russian).

The results are presented of chromosome analysis of the culture of human blood irradiated in the G_0 cycle at a dose of 200 R and 500 R. The number of aberrations and breaks at a dose of 500 R as related to a single cell and 1 R amounts to 0.0030 and 0.0057, respectively, i.e., 2.0 to 2.6 times higher than at a dose of 200 R. Aberrations both the chromosome and chromatid type were observed at a dose of 500 R. (auth)

24860 MODIFICATION OF CANCER CELLS RADIOSENSITIVITY. II. Influence of the Crabtree effect on radiosensitivity of Yoshida ascites sarcoma cells. Watras, J.; Widel, M. (Inst. of Oncology, Gliwice, Poland). Radiobiol.-Radiother.; 14: No. 1, 73-78(1973).

The Crabtree effect, induced by glucose addition to Yoshida ascites sarcoma cells with simultaneous irradiation in vivo, causes a significant increase of radiosensitivity of these cells. The increase of the radiation damage in the cells whose oxygen consumption was inhibited by glucose as compared to the damage of cells irradiated without use of glucose is characterized by the decrease of the frequency of appearance as well as by the slower development of tumors induced by subcutaneous transplantation of cancer cells to healthy recipient-rats. Data demonstrate also that the addition of insulin stimulates the action of glucose. The results of these experiments are evaluated as the consequence of the so-called oxygen effect. (auth)

Radiation Effects on Microorganisms

Refer also to abstracts 24368 and 24847.

24861 (EUR-4878) IMMUNOELECTROPHORESIS AND VERTICAL STARCH GEL ELECTROPHORESIS OF MEAT, FISH AND WHOLE-EGG PROTEINS IRRADIATED BY GAMMA-RAYS. Bugyaki, L.; van der Stichelen Rogier, M. (Rijks Instituut voor de Volksgezonheid, The Hague (Netherlands)). Jan 1973. 16p. (In French). Dep. NTIS (U. S. Sales Only). EUR FB 40,-.

Immunoelectrophoretic and electrophoretic methods were tested to determine whether they are able or not to detect the preirradiation of foods. Therefore, slices of raw meat (beef) and of fresh fish (cod), and homogenized whole hen eggs, were irradiated either at room temperature or at dry ice temperature (γ-source: ^{60}Co: irradiation rate: 0.4 Mrads/hr). The irradiation doses were 0.5 and 5 Mrads for the meat samples, and 0.5 and 1 Mrads for the fish and eggs samples. Irradiated and nonirradiated samples were stored in a refrigerator and in a deep-freezer until the proteins were extracted with a low ionic strength buffer. Immunoelectrophoresis in agar and agarose gels gave no significant differences between irradiated and test samples. With vertical starch gel electrophoresis significant differences appear between the electrophoretic patterns of irradiated and nonirradiated meat protein extracts. As for fish extracts, the electrophoretic patterns are very similar for irradiated and nonirradiated samples. For the egg proteins the differences between the electrophoretic patterns are mainly due to freezing, and irradiation modifications are too faint to be useful for identification purposes. (auth)

24862 DARK-RECOVERY IN A PETITE MUTANT OF SACCHAROMYCES CEREVISIAE IRRADIATED WITH ULTRAVIOLET LIGHT. Nunes de Langguth, E.; Gelos, U. (Departamento de Biofisica, Montevideo). Experientia; 28: No. 12, 1413-1415 (15 Dec 1972).

Cellular suspensions of petite and normal strains of S. cerevisiae in culture media containing various concentrations of glucose were exposed to ultraviolet radiation. The petite strain did not recover, but recovery of the normal strain was established. The recovery rate was dependent on the radiation dose and the glucose concentration of the medium. The maximum recovery was observed in a glucose concentration of 0.15%. (HLW)

24863 RECOVERY PHENOMENA IN YEAST SACCHAROMYCES CEREVISIAE. V. Combined action of visible light and liquid holding recovery on genetic effects of uv. Arman, I. P.; Kuznetsova, O. B. (Inst. of Atomic Energy, Moscow). Genetika; 8: No. 12, 149-159(Dec 1972). (In Russian).

The effect of photoreactivation on repair of lethal and mutagenic damage induced by uv is higher than the effect of postirradiation incubation in buffer (LHR). For recombinagenic effects the reverse is observed. Yeast cells were illuminated with visible light immediately after uv-irradiation and after different periods of incubation in buffer in normal for LH-recovery conditions and when protein synthesis was inhibited by actidion. The following results were obtained: incubation of cells in buffer after maximal photoreactivation gives additional repair of lethal and recombinagenic damage; the viability of yeast after photoreactivation carried out at different periods following LHR is a sum of the values of viabilities observed after these treatments when applied separately; the photoreversibility decreases during the incubation in buffer. When LHR is blocked by inhibiting the protein synthesis for 48 hours, the FR of lethal effect is absent and the viability of cells corresponds to the level observed immediately after uv irradiation. The possible mechanism of LH-recovery is discussed; it is suggested that LHR-system repairs the non-photoreactivable damages and is independent on dark repair after the stage of dimer excision, which is common for both non-replicative recovery systems (LHR and DR). (auth)

24864 REDUCING COMPOUNDS IN RADIOPROTECTION AND RADIOSENSITIZATION. Model experiments using ascorbic acid. Redpath, J. L.; Willson, R. L. (Mount Vernon Hospital, Northwood, Eng.). Int. J. Radiat. Biol.; 23: No. 1, 51-65(Jan 1973).

Ascorbic acid has been used in model experiments to investigate the possible roles of reducing agents in radioprotection and radiosensitization. The repair of organic radicals by their reaction with ascorbic acid was demonstrated directly using pulse radiolysis. Absolute rate constants for the reaction of the vitamin with hydroxyl radicals and secondary inorganic radical anions were determined. In the presence of ascorbic acid, the rapid reactions of the sensitizer triacetoneamine-N-oxyl (TAN), with the thymine hydroxyl adduct, or the isopropanol radical, were not observed. This was attributed to the rapid thermal reduction of the stable free radical. The resultant loss in radiosensitizing properties was confirmed by bacteriological studies using Serratia marcescens. In contrast, ascorbic acid has only an insignificant effect on the sensitizing action of the relatively stable compound p. nitroacetophenone (PNAP). (auth)

24865 STUDIES ON THE INFLUENCE OF RADIATION ON SACCHAROMYCES CEREVISIAE UNDER ANAEROBIC CONDITIONS. Bomar, M. T. (Bundesforschungsanstalt fuer Lebensmittelfrischhaltung, Karlsruhe, Ger.). Int. J. Appl. Radiat. Isotop.; 24: No. 1, 13-18(Jan 1973).

The following results were obtained by investigating the factors responsible for a higher rate of CO_2 production by irradiated starved yeast cells: the measurable injury of the cells starts some 30 min after irradiation (when measured at 30°C) with 1000 krad. The injury is irradiation dose-postirradiation time dependent; the CO_2 output increased with the increase of the temperature. The maximum is reached at about 50°C. Doses below 1000 krad caused no measurable CO_2 production. If followed by mechanical crushing, these low doses caused a CO_2 production that was lower than that produced by crushing alone; when the CO_2 production in crushed yeast had ceased, irradiation caused no CO_2 production. When CO_2 production in yeast irradiated with 1000 krad had ceased, no additional CO_2 production was produced by mechanical crushing. Both treatments apparently produced substrate for CO_2 production in a similar way; it seems that the enzymes responsible for CO_2 production are injured, directly or indirectly, with a dose as low as 250 krad; the postirradiation changes in the bursting strength of the cell and the changes in cell wall staining properties were quantitatively different from the changes in CO_2 output of the cell. Various structures of the cell respond differently to irradiation dose and postirradiation time: the reproduction of the cells shows the greatest sensitivity to irradiation. (auth)

24866 EFFECTS OF GROWTH INHIBITORS AND ULTRAVIOLET IRRADIATION ON F PILI. Novotny, C. P.; Taylor, P. F.; Lavin, K. (Univ. of Vermont, Burlington). J. Bacteriol.; 112: No. 3, 1083-1089(Dec 1972).

The effects of chloramphenicol, nalidixic acid, mitomycin C, NaCN, and uv irradiation at 253.7 nm on F pili production by Escherichia coli cells was studied by electron microscopy. The results show that cells contain pools of pili protein, and that assembly does not require synthesis of protein or deoxyribonucleic acid (DNA). NaCN (2×10^{-2} M) prevents the reappearance of pili and causes existing pili to disappear quickly from the cell surface. This suggests that energy is used in the assembly of pili and to retain pili on the cell. Cells irradiated with high doses (10^4 ergs/mm^2) of 253.7 nm light produce fewer pili, and these are shorter than normal. Dose-response curves for number of pili per cell and length of pili resemble single hit kinetics, showing 37% survival at 10^4 ergs/mm^2 and 2×10^4 ergs/mm^2, respectively. This suggests that DNA is at the site where pili are produced, and that it may be involved in the assembly of pili. (auth)

24867 STUDIES ON SEX PILI: MUTANTS OF THE SEX FACTOR F IN ESCHERICHIA COLI DEFECTIVE IN BACTERIOPHAGE ABSORBING FUNCTION OF F PILI. Tomoeda, M.; Shuta, A.; Inuzuka, M. (Kanazawa Univ., Japan). J. Bacteriol.; 112: No. 3, 1358-1363(Dec 1972).

Ultraviolet irradiation or nitrosoguanidine treatment of Escherichia coli K-12 strain JE3100 (F_8'/fla pil) led to the isolation of six mutants defective in F pili function. The defects were shown to be caused by mutations in the F factor. The mutants retained conjugal fertility, although they were less efficient than parental F_8' strain, and continued to synthesize F pili. Three of the mutants (strains KE196, 198, and 200) had lost sensitivity to male-specific MS2 phage, and the other three (strains KE161, 163, and 164) were insensitive to Qβ and f1 as well as MS2 phages. F pili on strains KE196, 198, and 200 cells continued to adsorb MS2 phage, whereas those of strains KE161, 163, and 164 did not absorb MS2 phage. The correlation of the mutant phenotypes with those of other F mutants reported in the literature is discussed. (auth)

24868 EXCISION REPAIR CHARACTERISTICS OF recB$^-$res$^-$ AND uvrC$^-$ STRAINS OF ESCHERICHIA COLI. Kato, T. (Osaka Univ.). J. Bacteriol.; 112: No. 3, 1237-1246(Dec 1972).

An Escherichia coli strain carrying the recB21 and res-1 mutations showed an abnormally low level of colony-forming ability although it grew essentially normally in liquid medium. The recB21 res-1 strain showed little, if any, of the ultraviolet (uv)-induced deoxyribonucleic acid (DNA) breakdown characteristic of the res-1 mutant. Nevertheless, the double mutant was far more sensitive to uv than either the res-1 or the recB21 strain. When compared with a wild-type strain, the rate of release of dimers from uv-irradiated DNA was very slow in the recB21 res-1, but normal in the res-1 recB$^+$ or recB21 res$^+$ mutants. However, the ratio of dimer-to-thymine released into the acid-soluble fraction was three times higher than the wild type in recB21 res$^+$ and recB21 res-1 and only one-tenth as high as the wild type in res-1 rec$^+$. Alkaline sucrose gradient centrifugation revealed occurrence of single-strand incision of uv-irradiated DNA and the restitution of nicked DNA at a similar rate in the recB21 res-1 and recB21 res$^+$ strains. Mutants uvrC$^-$ showed increased amounts of nicks in their DNA with increasing incubation time after uv irradiation, although no detectable amounts of dimers were excised from uv-irradiated DNA. From these results, it is concluded that the increased sensitivity of the res-1 strain to uv light is due to a reduced ability to excise dimers from uv-irradiated DNA and that the high rate of uv-induced breakdown of DNA is not the primary cause. A possible role of uvrC gene in the excision repair is discussed. (auth)

24869 ISOLATION OF THE REC MUTANTS IN STAPHYLOCOCCUS AUREUS. Inoue, M.; Oshima, H.; Okubo, T.; Mitsuhashi, S. (Gunma Univ., Maebashi, Japan). Bacteriol.; 112: No. 3, 1169-1176(Dec 1972).

A histidine auxotroph (his$^-$) of Staphylococcus aureus MS3937 and mutants sensitive to ultraviolet (uv) irradiation were obtained. The uv-sensitive mutants were found also to be sensitive to N-methyl-N'-nitro-N-nitrosoguanidine and mitomycin C, and their sensitivity was accounted for by a defect in deoxyribonucleic acid repair. Transduction of either chromosomal or plasmid markers to uv-sensitive mutants showed that these staphylococcus mutants are of the recA (reckless) type mutants as reported in Escherichia coli and Salmonella typhimurium; therefore the uv-sensitive mutants (uvr$^-$) were renamed recombination-deficient mutants (rec$^-$). The biochemical and genetic properties of these mutants are described, and their usefulness for studies of staphylococcal plasmids is discussed. (auth)

24870 DOMINANT MUTATIONS (LEX) IN ESCHERICHIA COLI K-12 WHICH AFFECT RADIATION SENSITIVITY AND FREQUENCY OF ULTRAVIOLET LIGHT-INDUCED MUTATIONS. Mount, D. W.; Low, K. B.; Edmiston, S. J. (Univ. of Arizona, Tucson). J. Bacteriol.; 112: No. 2, 886-893(Nov 1972).

Three mutations, denoted lex-1, -2, and -3, which increase the sensitivity of Escherichia coli K-12 to ultraviolet light (uv) and ionizing radiation, have been found by three-factor transduction crosses to be closely linked to uvrA on the E. coli K-12 linkage map. Strains bearing these mutations do not appear to be defective in genetic recombination although in some conjugational crosses they may fail to produce a normal yield of genetic recombinants depending upon the time of mating and the marker selected. The mutagenic activity of uv is decreased in the mutant strains. After irradiation with uv, cultures of the strains degrade their deoxyribonucleic acid at a high rate, similar to recA mutant strains. Stable lex$^+$/lec$^-$ heterozygotes are found to have the mutant radiation-sensitive phenotype of haploid lex$^-$ strains. (auth)

24871 HOST CELL DEOXYRIBONUCLEIC ACID POLYMERASE I AND THE SUPPORT OF T4 BACTERIOPHAGE GROWTH. George, D.; Rosenberg, D. (Rutgets—The State Univ., New Brunswick, NJ). J. Bacteriol.; 112: No. 2, 1017-1019(Nov 1972).

Ultraviolet irradiation of Escherichia coli polA cells reduces their capacity to support the growth of T4 phage. There is no additional loss of capacity observed in pol tsA recA double mutants at the nonpermissive temperature. The reversion frequency of a T4 rII mutant after uv irradiation is not changed by the absence of host deoxyribonucleic acid polymerase I. (auth)

24872 PROTECTIVE EFFECT OF TETRAHYDROFOLIC ACID (THFA) IN RADIATION INJURY. Koga, Y. (Showa Univ., Tokyo). Showa Igakkai Zasshi; 32: No. 5, 252-257(May 1972). (In Japanese).

It was expected that radiation damages might be protected by THFA, which is precursor of folic acid and an easily oxidized substance. Experiments were carried out to find the protective effect of THFA on both yeast cells and mice. In yeast cells, THFA (10^{-5} M) was effective in pretreatment but ineffective in post-treatment. There was no correlation between the protec-

tive effect and a labeled THFA concentration per cell. On the other hand, the number of mice surviving after 30 days increased significantly even in post-treatment, in which THFA (0.5 mg) was injected intraperitoneally at 6 h or 24 h after irradiation (500 R or 750 R). From these findings, it was supposed that THFA would effect as a reductive agent in yeast cells and as a promoter to the recovery of bone marrow cells resulting in the decrease of bone marrow death in mice. (auth)

24873 ADDITIONAL RECOVERY IN X-IRRADIATED OEDOGONIUM CARDIACUM CAN BE SUPPRESSED BY CYCLOHEXIMIDE. Horsley, R. J.; Laszlo, A. (Ontario Cancer Treatment and Research Foundation, Hamilton). 23: No. 2, 201-204(Feb 1973).

The role of protein synthesis inhibition in the observed additional recovery from x-ray induced sublethal damage was studied by comparing the split-dose survival curves obtained from irradiated Oedogonium cardiacum cells kept in the presence or absence of the protein inhibitor cycloheximide. No decrease in survival up to 16 hr of treatment was observed in G. cells irradiated with a dose of 2000 rads and treated with cycloheximide at 5 μg/ml. Two-dose fractionation curves, in cells treated with cycloheximide (5 and 10 μg/ml) were similar and remained unchanged from 4 to 16 hr. The cells did not progress through the cell-cycle at the same rate to reach the G_2 stage as did the cells in the control curve, in which survival decreased beyond 12 hr. The decrease in survival beyond 16 hr in cycloheximide treated cells could be caused either by delayed progression through the cell-cycle to G_2 or/and by prolonged inhibition of normal metabolism. Cells treated at both drug concentrations recovered from sublethal damage. However the magnitude of recovery extended from ~0.01 to ~0.11 fraction survival instead of ~0.01 to ~0.26 as seen in the controls. The fraction survival reached by cycloheximide-treated cells was close to the calculated value for full recovery i.e., ~0.08. It is suggested that full recovery takes place in the presence of cycloheximide, but the unexpected or additional recovery, shown in the controls, was suppressed. (UK)

24874 EFFECTS OF GAMMA RADIATION ON SPROUT INHIBITION, GROWTH OF MICROORGANISMS, AND CHEMICAL CONSTITUENTS OF SHONAN RED ONIONS. Chachin, K.; Kurosaki, T. (Osaka Prefectural Univ., Sakai, Japan). Engei Gakkai Zasshi; 40: No. 1, 91-97(Mar 1971). (In Japanese).

The effects of gamma irradiation on sprout inhibition, some chemical constituents, and the growth of Shonan red onions were studied. The onions were irradiated at doses of 15 to 250 Krad of ^{60}Co γ rays and stored at room temperature. The sprouting of Shonan red onions was completely prevented at a dose of 15 Krad. The percentage of rotting and weight loss during storage was higher in the onions of 250 Krad than in other lots. The softening of the scale texture occurred with doses of 125 and 250 Krad. The texture of sales of unirradiated and 15 Krad onions was crisp throughout the experiments. The activities of pectinmethylesterase were slightly higher in irradiated onions than in unirradiated ones at 50 days after irradiation. The decrease of ascorbic acid, anthocyanins, sugars, and some volatile contents were greater in the 250 Krad-onions than in other samples immediately after irradiation and during storage. The microorganisms, Penicillium sp., Aspergillus sp., bacteria, etc. were observed in Shonan red onions. The growth of molds on agar was suppressed at doses of 125 and 250 Krad, but there was more growth of bacteria in the onions of 125 and 250 Krad in comparison with that of 15 Krad and unirradiated. (auth)

24875 INFLUENCE OF X-IRRADIATION ON GROWTH AND RESPIRATION OF MICROCOCCUS DENITRIFICANS BEIJERINCK. Muetze, B. (Kernforschungsanlage, Juelich, Ger.). Zentralbl. Bakteriol. Parasitenk., Abt. II; 126: No. 4, 349-358(1971). (In German).

By means of manometric technique, the influence of x irradiation on the respiration of growing and resting cells of Micrococcus denitrificans under autotroph-aerobic and autotroph-anaerobic conditions was investigated. After an exposure of 15 kR, the colony forming ability was lost almost completely. The energy producing systems, however, were impaired after much higher irradiation exposures. Thus the H_2-oxidizing, nitrate reducing, and nitrite reducing enzyme systems are not very radiosensitive. After postirradiation conditions that enable the cells to multiply, most of the cells develop into giant cells. (auth)

24876 RADIOSTERILIZATION OF MEDICAL PRODUCTS. 12. Sterilization of Disposable Tube Stopper and Adaptor. Takuma, F.; Sato, K. (Tokyo Metropolitan Isotope Research Center). Ikakikaigaku Zasshi; 42: No. 5, 352-356(May 1972). (In Japanese).

An adaptor made of high density polyethylene and a stopper made of low density polyethylene were irradiated through 0 to 4 × 10^6 R of ^{60}Co γ rays and then examined with elution and bacteria tests to determine whether they can be sterilized by radiation. As the result of elution tests about heavy metal, evaporation residue, pH, and potassium permanganate consumption, none of the samples, irradiated or non-irradiated, showed contravention to the blood transfusion set standard. The maximum number of general living bacteria before sterilization was 10^1 order and the minimum irradiation dose necessary for 100% bactericidal rate was below 0.5×10^6 R. (Japan)

24877 EFFECTS OF IRRADIATION ON THE SURVIVAL OF VIRUS IN WEST COAST OYSTERS. Di Girolamo, R.; Liston, J.; Matches, J. (Coll. of Notre Dame, Belmont, CA). Appl. Microbiol.; 24: No. 6, 1005-1006(Dec 1972).

Gamma irradiation was evaluated as a means of inactivating poliovirus in shucked and whole shellfish. Results indicated that there was a significant survival of virus at all levels of radiation tested. (auth)

24878 FURTHER STUDIES ON THE ABORTIVE INFECTION OF MOUSE BRAIN CELL CULTURE WITH GUINEA PIG HERPES-LIKE VIRUS. Booss, J.; Hsiung, G. D. (Veterans Administration Hospital, West Haven, CT). Proc. Soc. Exp. Biol. Med.; 142: No. 3, 767-770(Mar 1973).

The abortive infection of mouse brain cells by GPHLV was further studied. Approximately 1 to 2% of mouse brain cells in an intact monolayer were found to contain nuclear inclusions 4 to 7 days after infection, and persisted for as long as 102 days. No qualitative difference between the inclusions produced by GPHLV in the infected mouse brain cells and that in the infected guinea pig brain cells was found by light microscopy. However, electron microscopy revealed that virions found in the 1 to 2% infected mouse brain cells were coreless. Attempts to adapt GPHLV to grow in mouse brain cells by serial passage were unsuccessful. Ultraviolet inactivation of the virus and serial dilution of the virus suspensions resulted in a progressive decrease in the numbers of inclusion formation in the mouse cell system. (auth)

24879 DAMAGING STRESSES TO FRESH AND IRRADIATED CITRUS FRUITS. Ahmed, E. M.; Martin, F. G.; Fluck, R. C. (Univ. of Florida, Gainesville). J. Food Sci.; 38: No. 2, 230-233(Feb 1973).

Oranges, grapefruit, and tangerines were exposed to 300 krad of ^{137}Cs gamma radiation. Times required to expose the fruits were calculated from the minimum dose rates. A flat plate was used to compress the fruit until point of rupture and a cylindrical probe was used to puncture the fruit; results are presented as the maximum force needed to rupture or puncture the fruit. A blank drill bit was used to puncture the peel oil glands. Weakening of the structural strength of the irradiated fruits was evident with their decreased resistance to applied forces. In all types of fruits the lowest value for each stress was obtained by the irradiated fruits. (HLW)

24880 SPECIFICITY OF THE MUTAGENIC ACTION OF FAST NEUTRONS. Kozhina, T. N. (Inst. of Nuclear Physics, Leningrad). Genetika; 9: No. 1, 168-170(Jan 1973). (In Russian).

The direct mutations to adenine dependence in the loci ad_1 and ad_2 in yeast Saccharomyces cerevisiae were isolated under the action of rays and fast neutrons. No significant difference in the ratio of the number of induced mutations between these two irradiations was found. Using the method of interallelic complementation for the construction of genetic maps of the locus ad_2, no specifity in the mutagenic action of fast neutrons in comparison with rays could be discovered. (auth)

24881 CONDITIONAL LETHAL RADIATION-SENSITIVE MUTANTS OF YEAST. II. THE SENSITIVITY TO ELEVATED TEMPERATURE AND THE CHARACTER OF CELL DIVISION. Bandas, E. L. (Inst. of Nuclear Physics, Leningrad). Genetika; 9: No. 1, 126-133(Jan 1973). (In Russian).

The influence of elevated temperature (37°C) on the survival of four mutant strains of Saccharomyces paradoxus was studied. Correlation was found between their responses to uv light, x rays, and temperature. The survival of strain 2 lowered not so sharply in the water at this temperature and the survival of strains 1, 4, and 5 did not decrease in this case at all. The elevated temperature caused an increase in the mitotic recombination frequency in the mutants 2, 4, 5, and in the strain of the wild type. The formation of buds and the cytokinesis of mutant cells were different from those in the control strain 51. The mutants gave in some cases the cells of elongated form that happened particularly widely in the strain 4. (auth)

24882 POSSIBLE RADIATION-INDUCED CHANGES IN THE PHYSIOLOGICAL QUALITY OF FOOD CROPS. Diehl, J. F. (Bundesforschungsanstalt fuer Lebensmittelfrischhaltung, Karlsruhe, Ger.). Ber. Landwirt.; 50: No. 2, 220-229(1972). (In German).

Food irradiation could be a contribution to environmental protection. Presently practiced chemical treatments could be replaced, in many instances, by this physical process which leaves no foreign residues in foods. The biological value of proteins is not significantly affected by the radiation doses needed in practical applications of radiation preservation. Vitamin losses increase with rising radiation dosage. They vary widely for different vitamins and are influenced by many factors. (GF)

24883 ANALYSIS OF ETHYLENIMINE-INDUCED AD-MUTANTS IN STRAINS OF SACCHAROMYCES CEREVISIAE DIFFERING IN SENSITIVITY TO UV- AND X-RAYS. Aleksandrova, N. N. (Leningrad State Pedagogical Inst.). Genetika; 9: No. 1, 122-125(Jan 1973). (In Russian).

Four strains of Saccharomyces cerevisiae carrying different mutations to radiosensitivity (wild type, uvs_1, xrs_1, xrs_4) were tested for allelic complementation of mutants in ad_2 locus. Ethylenimine was used as mutagen that induced ad-mutants. Tests for genotype showed that frequency of ad_2 genotype (among purple mutants) was 70% for each strain. Our data show that radiosensitive strains do not differ from wild type strains in their distribution of ad_2 mutants among three groups of complementation (nonpolarized, polarized, noncomplementing). Ethylenimine appeared to produce a high percentage of leaky (39,6 to 25,7%) and nonpolarized mutations (92,1 to 84,7%). Such results might bring forth the idea that, in Saccharomyces, ethylenimine mainly induces base-pair substitutions. (auth)

24884 ROLE OF THE REC A^+, REC B^+, REC C^+ DONOR GENES IN ESCHERICHIA COLI K-12 IN REPAIR OF REC^- RECIPIENTS EXPOSED TO GAMMA-RAYS IN ABSOLUTELY LETHAL DOSES. Rabinkova, E. V.; Torosyan, M. V. (Inst. of Biophysics, Moscow). Genetika; 9: No. 1, 102-111(Jan 1973). (In Russian).

The results of a study on repair of rec^- recipients that were exposed to γ rays in absolutely lethal doses by mating are presented. The repair occurs only after the donor DNA fragments, which carry rec^+ genes, are introduced into irradiated cells. It was established that maximal repair takes place when all the three genes rec A^+, rec B^+, and rec C^+ of the intact donor has occurred. The presence of rec A^+ gene in zygotes in obligatory for the repair process. It was shown that considerable repair occurs when the zygotes contain complete sets of rec wild alleles independent of their origin (whether they are contained in the chromosome of the irradiated recipient or in that of the intact donor). It was found that the irradiation-persistent recipient cells are mostly recombinants. A possibility of rec^+-dependent repair of γ-irradiated recipient not linked with genetic recombination is discussed. (auth)

24885 EFFECTS OF COMBINING ULTRAVIOLET REPAIR AND RECOMBINATION MUTATIONS IN HAEMOPHILUS INFLUENZAE. LeClerc, J. E.; Setlow, J. K. (Univ. of Tennessee, Oak Ridge). Nature (London) New Biol.; 241: No. 110, 172-174 (7 Feb 1973).

An attempt was made to produce an extremely sensitive strain of Haemophilus influenzae that would be defective in both types of repair of ultraviolet damage known to operate in this microorganism, i.e. excision and post-replication repair. It was impossible to isolate a strain with a mutation in both the rec1 and uvr1 gene. (The $rec1^-$ gene makes the cell recombination-defective and ultraviolet-sensitive due to a defect in post-replication repair. The $uvr1^-$ mutant is ultraviolet sensitive because of a defect in the specific endonuclease operating during the excision of ultraviolet-induced pyrimidine dimers). It was concluded that the inviability of the $rec1^-$ $uvr2^-$ double mutant was probably not attributable to a defect in repair or error-correcting mechanism normally maintaining the DNA, for two reasons. A viable $rec1^-$ $uvr2^-$ cell deficient in both types of repair was isolated. If error-correcting mechanisms were defective in one of the parent strains, one would expect the mutation rate in the strain to be higher rather than as observed significantly lower, or the same as in the wild type. It is suggested that the inviability of the $rec1^-$ $uvr1^-$ combination supports the view that the normal cell contains alternative pathways for the maintenance of its DNA, with multifunctional enzymes that can operate when another enzyme is defective. (UK)

24886 RECOVERY PHENOMENA IN YEAST SACCHAROMYCES CEREVISIAE. VI. The Induction of Reversions in uv Sensitive Yeasts and Liquid Holding Recovery. Kuznetsova, O. B.; Arman, I. P. (Inst. of Atomic Energy, Moscow). Genetika; 9: No. 1, 69-74(Jan 1973). (In Russian).

The rate of uv-induced mutations to try γ independence may be significantly reduced by prolonged postirradiation incubation in buffer (liquid holding recovery) in uv-sensitive mutants of yeasts Saccharomyces cerevisiae defective for liquid holding recovery of viability. The results obtained show that LHR of lethal and mutagenic action of uv occur independently. Mutagenic effect at the same uv-viability is lower in uv-sensitive mutants compared with resistant cells. These data together with the absence of induction of noticeable frequency of reversions to ur-independence in uv-sensitive mutants indicate the participation of dark repair in the origin of mutations. (auth)

24887 EFFECT OF UV IRRADIATION ON PHYTOPHTHORA INFESTANS (MONT) DE BARY. I. Survival Effect. Vishtynetskaya, T. A.; D'yakov, Yu. T.; Zav'yalova, L. A. (Moscow State Univ.). Genetika; 9: No. 1, 54-61(Jan 1973). (In Russian).

Specificity of lethal effect of uv irradiation on two physiological races of phytopathogenic fungus Phytophthora infestans was investigated. The lethal effect and uv susceptibility of encysted and motile zoospores and conidia was influenced by modification of post-irradiation conditions. The prolonged effect of uv irradiation (slow growth of the fungus and small size of its macroscopic colonies) is explained. On the basis of the data obtained, it is supposed that there are light and dark repair systems of reparation in zoospores of Phytophthora infestans. (auth)

24888 NEW REPRODUCTION METHOD IN A YEAST MUTANT STRAIN OBTAINED FROM CANDIDA UTILIS THROUGH UV RADIATION. Anghelova-Patarinska, Z. (Inst. of Plant Physiology, Sofia). Compt. Rend. Acad. Bulg. Sci.; 25: No. 12, 1705-1718(1972).

The yeast Mi-IV mutant strain, obtained by the uv radiation of the initial strain Candida utilis, revealed a new specific and hitherto not described reproduction method of yeast-like organisms belonging to the class of Fungi imperfecti. The new strain is distinguished by a number of morphological features in its cycle of growth and reproduction: cells varying in shape and size, usually oval or elliptic and ranging in size from 6 μ × 3.5 μ to 10 μ × 6.5 μ, but sometimes giant cells (20 μ × 8.5 μ) are also encountered; when abundantly aerated under arbitrary conditions, it forms a giant pseudomycelium up to 170 microns in diameter. (auth)

24889 PRODUCTION OF BACTERIAL ENDOTOXIN DETOXIFIED BY IONIZING RADIATION AND EXPERIMENTAL INVESTIGATION OF ITS EFFECT ON THE INCREASING OF THE NATURAL RESISTANCE. Bertok, L.; Kocsar, L. (Orszagos Frederic Joliot-Curie, Budapest). Izotoptechnika; 16: No. 11, 543-548(Nov 1972). (In Hungarian).

The protective effect of endotoxin detoxified by ^{60}Co γ irradiation was investigated. The advantages of this method of detoxification are compared with chemical detoxification. The possibilities of its use in therapy and zootherapy are discussed. (auth)

Radiation Effects on Plants

Refer also to abstract 24847.

24890 (TID-26280) EXPERIMENTAL EMBRYOGENESIS AND HISTOGENESIS IN PINUS LAMBERTIANA DOUGL. Final Report of Research Activities. Berlyn, G. P. (Yale Univ., New Haven, Conn. School of Forestry). 1971. Contract AT(30-1)-3444. 34p. Dep. NTIS.

When embryos of Pinus lambertiana grown in culture were x-irradiated, there were few morphological or histological changes at 200 R, but effects were evident at 600 R. The embryos were most radiosensitive during the first three days of development. Root meristems were the most sensitive tissues in the embryo. Electron microscope studies did not reveal any radioinduced changes in the fine structure of the cells. Investigations were also conducted on IAA and sucrose transport using ^{14}C as a tracer. (HLW)

24891 NUTRITIONAL VARIABILITY AMONG CLONES OF KENTUCKY-31 FESCUE FROM GAMMA AND NEUTRON IRRADIATED SEEDS. Lane, C. D. Jr. Knoxville, TN; Univ. of Tennessee (1972). 68p. University Microfilms Order No. 73-2470.

Thesis (Ph. D.).

The presence and magnitude of variation in nutritive value and yield of tall fescue (Festuca arundinacea) forage using the third generation clones descending from nonirradiated and gamma or neutron irradiated Kentucky-31 tall fescue seeds produced at the University of Tennessee-Atomic Energy Commission Agricultural Research Laboratory were studied. Specifically, the presence and magnitude of variation among forage families in measurements of nutritive value and yield (digestible dry matter, dry matter yield, digestible dry matter yield, crude protein and crude fiber) and measures of physical characteristics (color, plant density, leaf width and plant height) were determined at three harvests designated as seasons. To test the hypothesis of

family-season interaction, indices of forage quality were evaluated among seasons. Since the differences in physical characteristics of the plants were suspected to be related to forage quality and yield, coefficients of simple correlation between measures of nutritive value and yield and measures of visual characteristics were calculated. Forage from 122 three-foot row representing 36 families (each family representing the descendants from one irradiated seed) was selected for evaluation at each of three seasons. Forage was harvested on June 8, 1970 (summer harvest), February 24, 1971 (winter harvest) and April 22, 1971 (spring harvest). Crude protein, crude fiber and in vitro dry matter digestibility were determined. Dry matter yield was calculated from the weight of the forage harvested and the area clipped. Digestible dry matter yield was calculated as the product of in vitro dry matter digestibility and dry matter yield. The results of the statistical analysis indicated no significant interaction between family and season. Therefore, superior families at one season were also superior at the other seasons. The analysis of variance indicated that there were significant differences among family means in digestible dry matter, dry matter yield, crude protein and crude fiber. These results indicated that families of tall fescue were quite variable in all of the measurements of forage quality studied. However, there was not a single family that excelled in all of the measures of forage quality. In general, the families with the highest digestible dry matter percentages had the highest crude protein percentages and the lowest dry matter yield, digestible dry matter yield and crude fiber percentages. The average of family (least squares) means for summer, winter and spring, respectively, for the various measures of forage nutritive value and yield were as follows: digestible dry matter (%), 48, 56, 58; dry matter yield (M.T./A.), .62, .50, .50; digestible dry matter yield (M.T./A.), .31, .32, .30; crude protein (%), 9.0, 7.3, 15.3; and crude fiber (%), 23, 28, 23. The coefficient of variation among family means for summer, winter, and spring, respectively, were as follows: digestible dry matter, 12.6, 7.2, 8.0; dry matter yield, 31.2, 45.4, 35.9; crude protein, 8.9, 10.5, 11.2; and crude fiber, 11.2, 7.2, 8.5. The season when the coefficient of variation is the largest is the best time to make family selections because at that time sampling errors and errors in the determinations account for a smaller part of the total variation. The genetic, phenotypic, and environmental coefficients of correlation revealed that selection for digestible dry matter would tend to increase crude protein content and decrease crude fiber content, hopefully without an adverse effect on yield. In the spring, color was significantly correlated with crude protein and leaf width, while plant density and height were each significantly correlated with dry matter yield and digestible dry matter yield. In the winter, leaf width was significantly correlated with digestible dry matter yield. (Diss. Abstr.)

24892 EFFECT OF RADIATION ON THE BIOSYNTHESIS OF L TRYPTOPHAN FROM ^{14}C-ANTHRANILIC ACID IN KOHLRABI (BRASSICA OLERACEA L., VAR. GONGYLODES L.). Eder, J.; Kutacek, M. (Inst. of Experimental Botany, Prague). Biol. Plant. (Prague); 14: No. 6, 390-398(1972).

The metabolism of ^{14}C-anthranilic acid (^{14}C-AA) in kohlrabi (Brassica oleracea L. var. gongylodes L.) and the effect of radiation gamma ^{60}Co on this metabolism were investigated. In hypocotyl segments of seven day old etiolated seedlings ^{14}C-AA was metabolized partially to its detoxication product ^{14}C-β-glucoside of AA. Simultaneously L-tryptophan was also formed, which in these plants is a precursor of indolic glucosinolate glucobrassicin and neoglucobrassicin. The metabolism of ^{14}C-AA was followed for 97 h. Radiation, applied both to seeds and to seven day old plants did not affect the metabolism of ^{14}C-AA substantially. The intermediary reaction AA → L-tryptophan in the biosynthesis of L-tryptophan is not a radiosensitive part of the synthesis of this amino acid. A radiation sensitivity (max. 45%) was observed in the metabolic pathway leading from L-tryptophan to glucobrassicin. (auth)

24893 STUDIES OF IRRADIATED GUARA. Singh, B. P.; Chowdhury, J. B. (Haryana Agricultural Univ., Hissar, India). Nucleus (Calcutta); 15: No. 1, 16-22(Apr 1972).

The effects of gamma radiation on guara (Cyamposis tetragonoloba L. Taub.), an important fodder and grain legume (2n = 14), were studied. An attempt was made to isolate different variants produced in various treatments and to conduct cytological studies with regard to the presence of any chromosomal irregularities. These observations were correlated with the pollen fertility and seed set. (auth)

24894 EFFECTS OF MASS SELECTION AND IRRADIATION IN CORN MEASURED BY RANDOM S_1 LINES AND THEIR TESTCROSSES. Harris, R. E.; Gardner, C. O.; Compton, W. A. (Univ. of Nebraska, Lincoln). Crop Sci.; 12: No. 5, 594-598(1972).

Two populations of corn (Zea mays L.) improved by nine cycles of mass selection for yield and the unselected parent variety, "Hays Golden," were evaluated in 1969 and 1970 using random S_1 lines and their testcrosses to related and unrelated single-cross testers. One selected population received thermal neutron seed treatment prior to the first and third selection cycles. S_1 lines of the selected populations, per se and in testcrosses, demonstrated significant superiority in mean yield over lines of the parent variety in each year. Like progenies of the two selected populations produced similar yields. Selection evidently eliminated radiation-induced deleterious mutants from the "irradiated" population while increasing frequencies of favorable yield genes common to both selected populations. This apparently produced similar germ plasm reservoirs much more suitable for the extraction of superior inbred lines than the parent variety. Indications are that selection also reduced genetic variability in yield and combining ability. Prolificacy resulting from selection for yield was evident in S_1 lines but not in the testcrosses. Since inbreeding did not reduce prolificacy in the selected populations, results are interpreted to mean that tester genes masked recessive genes which induce prolific potential when homozygous. All phenotypic correlations between S_1 and testcross yields were too low to be of much predictive value; but in general, lines of the selected populations exhibited the least correlation with their testcrosses. Genetic correlations were somewhat higher, indicating sizeable environmental fluctuations in individual experiments. We postulate that non-prolific testers by inhibiting prolificacy in turn limit the expression of genes controlling yield in these populations. Use of a prolific tester might have provided greater yield differentiation, more precise estimates of line genotypes and higher correlations between S_1 and testcross progenies. (auth)

24895 ARTIFICIAL GENETIC IMPROVEMENT BY MEANS OF GAMMA RAYS APPLIED TO SEEDS OF TERRESTRIAL PLANTS. Sparano, O. Belgian Patent 725,512. 16 Dec 1968. Priority date 15 Dec 1967, Italy.

A radioactive treatment was carried out by means of ionizing radiation of short wavelength (gamma radiation) with variable exposure and absorbed doses according to the type of seeds and calculated so as to cause greatly improved rooting ability, a very rapid growth, an increase in productivity, a more abundant and better flowering and fructification, and longer period of preservation without refrigeration. (BE)

24896 EARLY AND LATE FLOWERING MUTATIONS INDUCED BY GAMMA RAYS IN VICIA FABA MINOR. Abo-Hegazi, A. M.; Tavcar, A. (Middle Eastern Regional Radioisotope Center for the Arab Countries, Cairo). Isotope Radiat. Res.; 5: 31-33 (Jun 1972).

In a program for inducing mutations by the use of gamma rays in the field bean (variety Giza 2), it was possible to obtain mutations, in the third generation, of early and late flowering after-seed irradiation with acute doses ranging from 500 to 5000 r. This proved the efficiency of the mutation method for the improvement of Vicia faba. (auth)

24897 EFFECT OF PRELIMINARY IRRADIATION OF BARLEY SEEDS WITH SMALL X-RAY DOSES ON THE MUTAGENIC ACTIVITY OF SOME MONOFUNCTIONAL ALKYLATING AGENTS. Olimpienko, G. S.; Vorob'eva, E. A.; Pechorina, A. N.; Mitrofanov, Yu. A.; Korotaeva, S. E. (Inst. of Biology, Petrozavodsk, USSR). Genetika; 9: No. 1, 30-38(Jan 1973). (In Russian).

The effect of preliminary irradiation of barley seeds (Hordeum distichon, var. nutans) with small doses of x rays (1500 R) on cytogenetic and mutagenic activity of ethylenimine, diethyl sulphate, and ethyl methane sulfonate was studied. Such a combination of mutagenic agents causes an increase in the spectrum of the variability of light-green chlorophyll-defective phenotypes and the decrease of albina mutation and its derivatives. Coefficients of correlation and regression for viable and chlorophyll mutants of different types were calculated. The effect of different procedures of seed treatment with mutagens on M_1 plants was demonstrated by data on the survival rate and growth intensity of their stalks and ears during the vegetative period. The level of cytogenetic breaks in anaphases of I and II pollen mother cells was also studied. (auth)

24898 TEST FOR ALLELISM OR CLOSE LINKAGE AMONG GENES FOR FLOWERING TIME IN ARABIDOPSIS THALIANA (L.) HEYNH. Hussein, H. A. S. (Univ., of Cairo). Egypt. J. Genet. Cytol.; 2: No. 1, 1-9(Jan 1973).

A number of crosses was done between mutant lines in Arabidopsis thaliana to test for allelism or close linkage among radioinduced gene mutations controlling flowering time. The data revealed new information regarding the linkage relationships among the loci involved. It was concluded that the loci governing this trait in A. thaliana are not evenly distributed all over the genome, but rather occur in a few clusters. (auth)

24899 EFFECT OF THE DOSE RATE OF GAMMA-IRRADIATION ON THE VARIABILITY OF QUANTITATIVE CHARACTERS IN THE POTATO IN PROGENY vM_2 AND M_1. Mezentsev, A. V.; Yashina, I. M. (Research Inst. of Potato Breeding, Moscow). Genetika; 9: No. 1, 39-45(Jan 1973). (In Russian).

Potato tubers of several strains were treated with γ rays of ^{60}Co at a dose of 3.5 kR at a dose rate of 50, 500, and 5000 R/min. Potato seeds of various origin were irradiated at a dose of 10 and 20 kR at a dose rate 50, 500, and 5000 R/min. An increase in the dose rate of irradiation was followed by an increase in amplitude of changeability with respect to yield and starch content in vegetative (vM_2) and generative (M_1) progenies. In progeny M_1, the dose rate of 5000 R/min induced much more chlorophyll mutations than the dose rate of 50 and 5000 R/min. (auth)

24900 VARIATION OF RELATIVE BIOLOGICAL EFFECTIVENESS WITH DOSE RATE FOR DIFFERENT RADIATION QUALITIES. Berry, R. J.; Cavanagh, J.; Oliver, R.; Winston, B. M. (Churchill Hospital, Oxford). Health Phys.; 24: No. 4, 369-374 (Apr 1973).

Measurement of inhibition of root growth in seedlings of Vicia faba following exposure has been used to compare the effectiveness of x and γ rays of different energies from 84 keV (from ^{170}Tm) to several MeV (from ^{60}Co and radium) and of exposure at various dose rates. The data are compared with earlier published results from the same laboratory for irradiation with low-energy beta particles from ^{3}H. Because of the reduced effectiveness of radiation delivered at low dose-rates, when compared to 220 to 250 kVp x radiation at 50 to 65 rad/min, exposure at 1.5 rad/hr provides, as a safety factor, a dose ratio of 1.2 for ^{170}Tm γ rays, 2.2 for ^{3}H β particles, and between 1.9 and 2.8 for radium γ rays. However, if radium γ radiation at low dose-rates is to be taken as the reference for exposure in view of long clinical experience with these sources in radiotherapy, at 1.5 to 1.75 rad/hr an RBE value of between 0.9 and 1.3 must be allowed for ^{3}H β particles and between 1.6 and 2.3 for low energy ^{170}Tm γ radiation. For exposure at 46 to 60 rad/hr the corresponding values are 1.0 and 1.5 for ^{3}H β and ^{170}Tm γ respectively. (auth)

24901 RICE BREEDING WITH INDUCED MUTATIONS. Miah, A. J.; Mustafa, G.; Soomro, A. M. (Atomic Energy Agricultural Research Centre, Tandojam, Pakistan). Pak. J. Sci. Ind. Res.; 15: No. 1-2, 75-78(1972).

Mutation research was initiated in rice with the following aims: to induce dwarfness in Dokri Basmati and Jajai-77; to compare the effects of gamma rays and fast neutrons on the induction of chlorophyll mutations in IR8 and Mehran 69 (from IR6-156-2); to improve the grain quality of IR8; and to shorten the maturity period of Mehran 69. The preliminary findings are described in this report. Both gamma rays and fast neutrons gave rise to short-culm mutants in Dokri Basmati; early ripening and grain-size mutants in Jajai-77. In M_3 each of the mutants from both the varieties was found to maintain its mutated characteristics with concurrent changes in some other agronomic traits. These changes occurred in both positive and negative directions. Preliminary yield tests of the M_4 lines showed that one of the short-culm mutants (S-10) of Dokri Basmati and two of the grain-size mutants (large grain-2 and large grain-3) of Jajai-77 retained the parent level of grain yield while in the rest of the mutant lines of both Dokri Basmati and Jajai-77, the grain yield was reduced significantly as compared to their respective parents. The frequency of M_2 chlorophyll mutations was increased by gamma rays and fast neutron treatments in both IR8 and Mehran 69. However, the rate of increase was not proportional to doses. The mutagenic efficiency of the two radiations was more or less the same. Mutagenic effectiveness, on the other hand, was generally highest at lower doses and neutrons 10 to 30 times more effective than gamma rays. (auth)

24902 EFFECT OF RADIATION ON POLLEN AND SPIKELET FERTILITY IN RICE. Saha, C. S.; Awan, M. A.; Bari, G. (Radiation Genetics Inst., Lyallpur, Pakistan). Pak. J. Sci. Ind. Res.; 15: No. 1-2, 79-80(1972).

Dry seeds of rice variety 370-Basmati were exposed to fast neutron doses ranging from 1.0 to 2.5 kR and gamma-rays from 15 kR to 30 kR, and the data on pollen and spikelet fertility were recorded in M_1 generation. There was a very high negative correlation between the radiation dosage and the fertility on pollen grains and spikelets. Neutrons had more serious effect than gamma rays. (auth)

24903 THEORY OF RADIOBIOLOGICAL EFFECT OF INTENSIVE ^{60}Co γ-RADIATION IN HELIANTHUS ANNUUS L. Kovachik, A. (Inst. of Genetics and Breeding, Prague). Tsitol. Genet.; 6: No. 6, 529-540(1972). (In Russian).

Data on the effect of intensive ^{60}Co γ radiation on Helianthus annuus L. ontogeny was obtained. In this connection, the influence of achene hydration extent on the radiation effect, influence of pericarp on radiosensitivity, processes of development and growth of irradiated sunflower plants as well as the influence of the irradiated achene storage period on initial growth and development, dynamics of biochemical processes, including metabolism of phosphorus, amino acids, saccharides, and nitrogenous substances in sunflower plants were studied. These results are of use in establishing some peculiarities in dependence of radiobiological action expressed by depression of growth and development from the storage period of irradiated seed material. Maximum effect of radiation was manifested after storage of irradiated seed material of sunflower during a week. This fact is of great importance for the further decoding of the reparation mechanism. (auth)

Radiation Effects on Animals

Man

Refer also to abstracts 24287, 24507, 24859, 25079, 27150, and 27159.

24904 (ICRU-23) MEASUREMENT OF ABSORBED DOSE IN A PHANTOM IRRADIATED BY A SINGLE BEAM OF X OR GAMMA RAYS. (International Commission on Radiation Units and Measurements, Washington, D. C.). 15 Jan 1973. 37p. ICRU Publications, Washington, DC $3.00.

The aim of clinical radiation dosimetry is the precise statement of the absorbed dose at all points of interest in an irradiated patient. Since direct measurement is seldom possible, and always fraught with great difficulty, indirect methods are usually employed. Recommendations, measuring techniques, and numerical values proposed by the International Commission on Radiological Units (ICRU) for measurements of absorbed γ or x are presented. Four stages are usually involved. First, a determination of the radiation is made at the calibration point. This determination can be considered to be the calibration of the beam. Such a determination is required for all beam sizes and source distances that are to be used. In the special case of low energy (below 150 kV) x rays, the quantity determined is the exposure rate and the determination is free in air. For all other photon energies, the quantity determined is the absorbed-dose rate at the specified point in standard (water) phantom. The position of this specified point depends on the energy of the photon beam. Secondly, the peak absorbed-dose rates or, for low energies, the surface absorbed-dose rates, are deduced either by relative measurements or, more usually, with the aid of published depth-dose tables. In the third stage, the absorbed-dose rate at any point of interest is related to the peak or surface absorbed-dose rate by the use of appropriate standard depth-dose tables and isodose charts. Finally, allowance may have to be made for the fact that the shape, size, and composition of the patient are different from those of the phantom in which the standard measurements were made. These allowances are not dealt with in this report, it being planned that they will be included in a report being prepared. (CH)

24905 (NRPB-R-7) RADIOLOGICAL IMPLICATIONS OF USING BY PRODUCT GYPSUM AS A BUILDING MATERIAL. O'Riordan, M. C.; Duggan, M. J.; Rose, W. B.; Bradford, G. F. (National Radiological Protection Board, Harwell (England)). Dec 1972. 28p. Dep. NTIS (U.S. Sales Only) $3.50.

By-product gypsum, produced as a waste in the phosphate industry, could be used in bulk as a building material, but it has a radium content higher than that of other building materials, and thus raises the question whether or not the resulting radiation doses to individuals and to the human population of the country as a whole are acceptable. The typical radium content is 25 ρCi/g, and the corresponding dose rate from γ rays to the gonads and bone marrow of the occupants of a house would be 30 mrad/yr, if by-product gypsum were a substantial constituent. This is comparable with the regional variations in the dose rate due to natural background radiation in Great Britain, and less than the local variations. If as many as 10% of all new houses were eventually so constructed, the resulting gonad dose rate averaged over the population would ultimately reach 3 mrad/yr, or about 3% of that from the natural background. Exposures from β radiation and radon would be less than the regional variations in natural exposures. All the annual doses are at least a factor of 10 below the dose limits recommended by the International Commission on Radiological Protection for exposure of the human population. (CH)

24906 (TID-26273) STUDY OF IRRADIATION EFFECTS ON THE HUMAN TESTIS: INCLUDING HISTOLOGIC, CHROMOSOMAL, AND HORMONAL ASPECTS. Terminal Progress Report. Paulsen, C. A. (Washington Univ., Seattle. School

of Medicine). 31 Jan 1973. Contract AT(45-1)-2225. 81p. Dep. NTIS.

Separate abstracts were prepared on two sections of this report. (CH)

For abstracts of individual sections see: 24907 and 24908.

24907 (TID-26273, pp 1-26) [STUDY OF IRRADIATION EFFECTS ON THE HUMAN TESTIS: INCLUDING HISTOLOGIC, CHROMOSOMAL, AND HORMONAL ASPECTS]. 31 Jan 1973.

Study of irradiation effects on the human testis: including histologic, chromosomal, and hormonal aspects.

Results are summarized from a study on the effects of acute local x irradiation on the cytology and function of the human testes. Data were collected during a six-year period following exposure to doses ranging from 7.5 R to 400 R on sperm production, levels of luteinizing hormone (LH) and testosterone in blood serum, levels of LH and follicle-stimulating hormone (FSH) in urine, and chromosome aberrations and other changes in the cytology of tissue samples obtained by biopsy or vasectomy at various times following irradiation. Data were also collected on individual variations in sperm production by non-irradiated males. A list of 18 publications during the study period is included. (CH)

24908 (TID-26273, pp 27-28) PITTSBURGH ACCIDENT. [Dosimetry Based on Sperm Counts and Gonadotrophin Levels].

Study of irradiation effects on the human testis: including histologic, chromosomal, and hormonal aspects.

Three individuals were exposed to x radiation from the gold target of a linear accelerator. Film badge readings were 550 R for two of the men and 110 R for the other; with one receiving an estimated dose of at least 1000 R to several body areas. Sperm counts and follicle-stimulating hormone (FSH) and luteinizing hormone (LH) levels were used to estimate the dose to the gonads. Changes observed during the six-year period following acute irradiation are reported. Sperm counts following exposure to an estimated dose of 550 R returned to a satisfactory level after about 1000 days and serum gonadotrophin (FSH and LH) levels of the three individuals had returned to normal by the end of the six-year study period. (CH)

24909 SEVERE ACUTE RADIATION INJURIES OF THE HANDS. Krizek, T. J.; Ariyan, S. (Yale Univ., New Haven). Plast. Reconstr. Surg.; 51: No. 1, 14-22(Jan 1973).

Two cases of acute radiation injury of patients are presented, whose hands were exposed to high dose x radiation, ranging from 19,500 rads to 250,000 rads. Adequate resurfacing resulted in relief from pain, gain of functional range of motion, and salvage of the parts. (auth)

24910 SUBJECTIVE EXPERIENCES DURING A 32-YEAR PERIOD AFTER RESURFACING OF HANDS FOR SEVERE AND ACUTE RADIATION BURNS. Smith, S. M. (Univ. of Utah, Salt Lake City). Plast. Reconstr. Surg.; 51: No. 1, 23-26 (Jan 1973).

Thirty-two years of experience with hands skin-grafted after a severe acute radiation injury are summarized, from the subjective viewpoint. (auth)

24911 PREDICTING LIGHT FLASHES DUE TO α-PARTICLE FLUX ON SST PLANES. Young, P. S. (Mississippi State Univ., State College); Fukui, K. Nature (London); 241: No. 5385, 112-113(12 Jan 1973).

Reference is made to the observation of light flashes by Apollo astronauts when traveling outside the geomagnetic sphere of the Earth. Experiments to determine the causes of this phenomenon indicated that the flashes were caused either by direct interaction between energetic heavy primary cosmic rays or neutrons and the retina, or by Cherenkov radiation produced by muons. Experiments at Berkeley, however, showed that fast α particles produced flashes and streaks when they stopped inside the eye or penetrated through the retina, and the possibility of observing light flashes on SST aircraft due to α particles was investigated. The aircraft, carrying an emulsion plastic detector stack, flew over Alaska during the non-flare period from June to August 1970, and calculations indicated that aircraft passengers could observe 75 flashes/hr due to α particles, a rather alarming result. Difficulties in carrying out the analysis are, however, emphasized. (UK)

24912 UNEQUIVOCAL CLINICAL EVIDENCE FOR THE OXYGEN EFFECT. Henk, J. M.; Smith, C. W. (Velindre Hospital, Whitchurch, Eng.). Brit. J. Radiol.; 46: No. 542, 146(Feb 1973).

Attention is briefly drawn to the controlled Cardiff trial of radiotherapy and hyperbaric oxygen in advanced head and neck cancer. Patients admitted to the trial totalled 291 up to the end of 1971. All were treated with 10 fractions 3 times/week to a tumor dose of 3,500 to 4,500 rads according to field size. There was improvement in tumor control probability from hyperbaric oxygen compared with the controls treated in air. The latest two-year figures were 56% for hyperbaric oxygen patients and 34% for controls. The trial has not shown significant increase in survival rates and the gain in therapeutic ratio is questioned, but it is pointed out that there seems to be no explanation for the tumor control rates other than the existence of an oxygen effect in human squamous carcinoma. (UK)

24913 DAMAGES OF THE SMALL INTESTINE BY TELECOBALT PENDULUM IRRADIATION OF THE RENAL REGION. Vergau, W.; Buerkle, G.; Herzer, R.; Sadowski, P. (Univ., Tuebingen, Ger.). Strahlentherapie; 144: No. 6, 697-712(Dec 1972). (In German).

Thirty-one patients, treated by postoperative telecobalt pendulum irradiation after nephrectomy for hypernephroid carcinoma, were examined with regard to side effects within the upper small intestine. The following findings were evaluated: the clinical symptoms, x-ray examinations of stomach and small intestine and in 14 patients the examination by incident light microscope and histological examination of an aspiration biopsy from the small intestine. It was found that to a high degree damage to the intestinal sections within the irradiation volume is to be expected. This must be taken into consideration in irradiation planning. The monoaxial and mono-segmental pendulum technique offers a relatively favourable dose distribution. (auth)

24914 ALTERATIONS ON THE DUODENUM AFTER ^{60}Co TELETHERAPY OF HYPERNEPHROMAS. Lackner, J.; Schroeter, J. (Zentralroentgeninstitut, Herford, Ger.). Strahlentherapie; 144: No. 6, 691-696(Dec 1972). (In German).

The case histories of two patients are reported, who suffered from severe complaints during or immediately after radiotherapy, partly complicated by ileus symptoms. Changes in the duodenum were found radiologically, not distinguishable from a neoplastic process, for example such as a metastasis. Endoscopy and histology led to the definitive diagnosis. (auth)

24915 ALKALINE PHOSPHATASE AND TRANSAMINASES IN SERUM DURING RADIOTHERAPY OF GENITAL CARCINOMA IN WOMEN. Engelhardt, W.; Penning, W. (Univ., Munich). Muenchen. Med. Wochenschr.; 114: No. 44, 1914-1916(1972). (In German).

In 70 female patients who were irradiated because of genital carcinoma, the activities of the alkaline phosphatase (AP), of the glutamate pyruvate transaminase (GPT), and of the glutamate oxalacetate transaminase (GOT) in the serum were determined. While the AP and SGPT showed uncharacteristic behavior, the number of patients with nearly normal SGOT levels after the end of irradiation decreased by a quarter. It was assumed, and attempts were made to substantiate it, that this was a radioinduced liberation of enzymes as a direct or indirect effect of irradiation. Increases in concentration of SGOT should only be evaluated as a radiation effect if other organic diseases have been excluded. (GF)

24916 RADIOPROTECTION OF THE SKIN. Bouillon, C. Prod. Probl. Pharm.; 27: No. 8, 724-746(Aug 1972). (In French).

The increased exposure of individuals to radiations resulting from outdoor activities and the increased use of x rays and radioisotopes in industry and medicine necessitate the use of radioprotecting substances. The chemical and biological effects (both ionizing and actinic) of radiations are reviewed. The principal protection systems are briefly discussed and the proposed lines of action are presented. (auth)

24917 PLANNING, CONSTRUCTION, AND OUTFITTING OF A CENTRAL ISOTOPE DEPARTMENT FOR A CLINICAL UNIT. Hundeshagen, Heinz (Inst. for Nuclear Medicine and Special Biophysics, Hanover). Magy. Radiol.; 24: No. 6, 370-373(1972). (In Hungarian).

During the planning stage for the new medical school in Hanover, the field of activity and the administrative structure of the proposed central isotope institute were established, before proceeding with the design of the buildings. The new department was centrally located with respect to the clinical services but it was housed in a separate building, in which space was provided for diagnostic, therapeutic, and research activities. The department serves hospitals with a total of 3500 beds, including 1800 in the university clinic; the rest of the beds are in the local municipal hospitals. Training of physicians and other specialists is an important function of the institute. The same physician is in charge of all related examinations for given patients, without differentiating between in-vivo and in-vitro tests. The total surface area of the building, which also includes the x-ray therapy department, is 6200 m^2. The architectural isolation of the research

reactor, cyclotron, whole-body counter and other major research and examination tools presented some difficulties. Twelve shielded cells are provided for preparing and handling the needed diagnostic and therapeutic radioactive materials. All work areas are provided with remotely controlled means for transportation and handling. The activity in the ambient air and at specific locations is automatically recorded in the central computer. The output of the fast scanners and other special instruments is also entered directly. The therapy section has twelve beds for patients. The staff includes 25 physicians and 13 other scientific workers. Radiation protection problems received special attention. (TTT)

24918 CHROMOSOMAL ABERRATIONS IN MAN DUE TO LOW LEVELS OF IONIZING RADIATION: A PILOT STUDY. Depenbusch, F. L. (Naval Hospital, Long Beach, Ca.). Mil. Med.; 137: No. 12, 436-440(Dec 1972).

A review of the effects of high levels and low levels of ionizing radiation on the body is presented. The effects of low levels of radiation in relation to chromosomal aberrations are discussed in detail. The results of a comparison study of chromosomal aberrations between a group of subjects exposed to ionizing radiation and a control group are presented. A slightly higher percentage of chromosomal aberrations was noted among the exposed group. This is not felt to be of significance, because of the small number of cells examined and because of the small number of subjects in the study. The study does, however, represent an approach to determining the threshold effect in humans. A method is described of transporting serum in a culture medium over great distances to a laboratory, which involves the inoculation of the culture medium with supernatant plasma prior to shipping. (auth)

24919 EXPOSURES OF PERSONNEL TO LABORATORY HAZARDS. Fawcett, H. H. (National Research Council, Washington, DC). Amer. Ind. Hyg. Ass. J.; 33: No. 8, 559-567(Aug 1972).

Basic attitudes, philosophy, knowledge, and misinformation compete with "academic freedom" when related to the prevention of accidents and health impairment in laboratories. Medical supervision, accident prevention, fire prevention, radiation control, and industrial hygiene are positive protective efforts that should be closely inter-related and interdependent. Protective activity can be successful only as it supplements the work of other activity toward the goal of freedom from hazards in the laboratory environment. (auth)

24920 COMPARATIVE ABSORBED DOSES IN DENTAL RADIOGRAPHY. III. Special Projections. Weissman, D. D. (Univ. of California, Los Angeles). J. Dent. Res.; 52: No. 2, 366-370 (1973).

X-radiation dosimetry of four intraoral occlusal and four extraoral skull projections at 12 anatomic sites was performed with calcium fluoride thermoluminescent dosimeters. The degree of exposure and absorbed doses indicated that patient radiation tolerance should be considered in the decision to use radiography. (auth)

24921 BIOLOGICAL PROPERTIES OF ^{252}Cf. Atkins, H. L.; Fairchild, R. G.; Drew, R. M. (Brookhaven National Lab., Upton, NY). Amer. J. Roentgenol., Radium Ther. Nucl. Med.; 117: No. 3, 704-710(Mar 1973).

There is good biological evidence for an enhanced effect of californium-252 on tumors because of a reduced necessity for the presence of oxygen during the period of irradiation. This is the primary reason for consideration of its use in interstitial and intracavitary cancer therapy. Balanced against this is the complexity of dosage calculation and the variability of RBE depending on dose rate. The difficulties in storage and handling due to special hazards must also be considered. Because of these problems a careful evaluation of californium-252 must be carried out prior to its routine clinical use. With the known difficulties in carrying out such evaluations (lack of sufficient suitable clinical material in any one institution, variability in clinical problems with the same malignancy, differences in technique of application and reluctance to use a new modality in situations where standard methods are relatively successful) it would seem wise to have a collaborative clinical trial involving a number of cooperative institutions under supervision on a national level. (auth)

24922 RADIOGRAPHY OF POTENTIALLY PREGNANT FEMALES. Gillanders, L. A. (Royal Infirmary, Aberdeen, Scotland). Brit. Med. J.; 1: No. 5848, 291-292(3 Feb 1973).

A brief letter invites comment on the difficulties of application of the recommendations of the Dept. of Health concerning radiography of potentially pregnant females. This states that radiological examinations involving the lower abdomen should, if practicable, be carried out within the first 10 days following the first day of the menstrual period. The Aberdeen hospitals have applied a 28 day rule for 5 yrs previous to the communication. This practice does not prevent irradiation of a 10 to 18 day fetus, but protects older fetuses with minimal delay and inconvenience within the system. (UK)

24923 GENERAL EQUATION FOR THE CALCULATION OF NOMINAL STANDARD DOSE. Dixon, R. L. (Wake Forest Univ., Winston-Salem, NC). Acta Radiol., Ther., Phys., Biol.; 11: No. 4, 305-311(Aug 1972).

A general equation is derived that can be used to calculate a nominal standard dose or ret dose for any treatment schedule, no matter how complex. A computer program for such calculations is described. (auth)

24924 DETERMINATION OF DOSE DISTRIBUTION IN THE PELVIS BY MEASUREMENT AND BY COMPUTER IN GYNECOLOGIC RADIATION THERAPY. Joelsson, I.; Ruden, B. I.; Costa, A.; Dutreix, A.; Rosenwald, J. C. (Karolinska Institutet, Stockholm). Acta Radiol., Ther., Phys., Biol.; 11: No. 4, 289-304(Aug 1972).

The correspondence between doses in various parts of the pelvis as measured with LiF dosimeters or calculated by means of a computer was investigated. Close correlation of dose values along the external iliac veins with a discrepancy for those along the common iliac vein were evident. The discrepancy may be explained by the movement in caudal and dorsal direction of the heavy radium irradiators during lengthy periods of treatment. (auth)

24925 ROENTGENOLOGIC EXAMINATION OF THE LARYNX. A Clinical Comparison. Hemmingsson, A. (Akademiska Sjukhuset, Uppsala). Acta Radiol., Diagn.; 12: No. 4, 433-451 (Jul 1972).

Different methods of roentgenologic examination of the larynx, namely tomography, ordinary radiography with a high potential technique, laryngography, and cinematography were compared. The results in 119 examinations indicated that laryngography is the most reliable method in adults, while cinematography was the method of choice in small children. Ordinary radiography with a high potential technique should be used if a positive contrast examination must be excluded, while tomography is an advantage in only a few cases. (auth)

24926 ABSORBED DOSES IN THE TISSUES OF CRITICAL ORGANS OF PATIENTS IN ROENTGENODIAGNOSIS AND MEASURES OF PROTECTION AGAINST RADIATION. Telichko, F. F. (Uzhgorod State Univ., USSR). Med. Radiol.; 18: No. 3, 53-60 (Mar 1973). (In Russian).

A calculation-measuring method was used to determine doses absorbed by superficial tissues of the critical organs (skin, gonads, and bone marrow) at 50 to 100 kV, with examination areas of 100 to 200 m^2 during various methods of x-ray investigation. When comparing the decrease of the absorbed doses with different combinations of conditions providing a satisfactory quality of the image it was established that the greatest decrease of the absorbed doses can be reached with an increase in the thickness of an additional filter and with an increase of the voltage required in combination with lessening of the area to the size of the examined site, as well as with the increase of the additional filter, maximally useful increase of the additional filter, maximally useful increase of voltage, and possible reduction exposure in combination with the decrease of the irradiated area. (auth)

24927 FAST NEUTRON THERAPY. Rowland, L.; Morgan, M. A. (Royal Marsden Hospital, London). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 9, 562-577(1972).

From sixth international cyclotron conference; Vancouver, B. C. (18 Jul 1972).

See CONF-720717-.

The rationale of fast neutron therapy is discussed and some early results obtained at the Medical Research Council's Cyclotron Unit at Hammersmith Hospital, London are presented. The importance of the oxygen enhancement ratio for fast neutrons is considered, together with the significance of the small proportion of anoxic cells present in most tumors. The significant features of the preliminary results obtained in patients with malignant disease are presented and the characteristics of fast neutron beams for radiotherapy are discussed. (auth)

24928 RADIOSENSITIZATION OF CEREBRAL TUMORS WITH HALOID ANALOGS OF PYRIMIDINE BASES. Lokshina, A. M.; Pelevina, I. I. Med. Radiol.; 18: No. 3, 70-77(Mar 1973). (In Russian).

The overwhelming majority of the therapy studies on malignant brain tumors were performed with x-ray or ^{60}Co radiation, and in general radiation treatment yielded results superior to surgery. A number of techniques are available for increasing the radiation sensitivity of malignant cells: raising the O_2 pressure, lowering the level of natural cell protection (blocking sulfhydryl groups), DNA synthesis inhibitors, and the change of DNA struc-

ture by the use of haloid analogs of pyrimidine bases. Details of this type of synthesis are recounted in this review, and experimental data are cited from in vitro and in vivo studies. 47 references. (KSW).

24929 METHOD OF GONAD PROTECTION. Fischel, R. (Kaplan Hospital, Rehovoth, Israel). Acta Radiol., Diagn.; 12: No. 3, 396-398(May 1972).

A device, the "hip-mask", for protection of the gonads at roentgenography of the hip joints in children is described. The device is simple and effective. Measurements failed to indicate any untoward irradiation of the infant. (auth)

24930 CHILDHOOD CANCER FOLLOWING OBSTETRIC RADIOGRAPHY. Shore, F. J.; Robertson, J. S.; Bateman, J. L. (Queens Coll., New York). Health Phys.; 24: No. 2, 258-260 (Feb 1973).

Questions are raised concerning the work of Stewart and Kneale (Lancet; 1: 1185 (1970) and 104 (1968)) on obstetric x rays and childhood cancer and the criticisms of this work by several authors. Data previously presented are reconsidered from which it would appear that the dose response is a strong function of the epoch in which the children were born. It is concluded that although the data of Stewart and Kneale appear to indicate excess mortality, the magnitude of the effect is open to question and also the linear relation of malignancy response to dose that other workers have put forward using the same data is questionable. (UK)

24931 SOME INDICES OF DISINTEGRATION OF DNA IN PATIENTS SUBJECTED TO TOTAL FRACTIONAL GAMMA THERAPY. Tarakanova, M. P.; Vorob'ev, A. I.; Fedorova, T. A. Med. Radiol.; 18: No. 3, 44-50(Mar 1973). (In Russian).

When studying the excretion of desoxycytidine in four patients subjected to total fractional gamma irradiation in a dose of 30 to 50 R per seance, an increase of the excretion by 1.2 to 2.6 times during 1 to 3 days after each irradiation was observed. The greatest increase of desoxycytidine excretion was observed in patients to whom gamma therapy was administered in the presence of total blast metaplasia of the bone marrow or multiple extramedullary foci of tumorous growth. A total amount of excreted compounds behaving similarly to desoxycytidine on the ion-exchange resins and participating in the reaction to desoxyribose with thiobarbituric acid under the same conditions as desoxycytidine was found to be also increased after each seance of radiation treatment by 1.6 to 2.8 times. (auth)

24932 CARCINOGENIC EFFECTS OF LOW LEVEL RADIATION. A Re-appraisal of Epidemiologists Methods and Observations. Stewart, A. (Oxford Univ.). Health Phys.; 24: No. 2, 223-240(Feb 1973).

The Oxford survey and related studies of leukemia mortality have shown that it is unusual to be x-rayed within 6 months of conception, but not uncommon for a spontaneous cancer to be initiated during the first half of fetal life and to wind up as a stillbirth, a neonatal death, or a fatal infection. These missed cases tend to be associated with early initiations, and with cancers which run an exceptionally acute course without tumor formation, so they have affected the recognition of leukemias more than other cancers, myeloid leukemias more than lymphatic ones, and spontaneous cancers more than radiogenic ones. The unrecognized cases are also associated with difficult births and difficult living conditions so they have affected x-rayed fetuses more than other fetuses, negroes more than caucasians, and A-bomb survivors more than other populations. A concentration of unrecognized cancers in the youngest age groups, and in populations with a high all-causes death rate, explains why studies of the delayed effects of prenatal irradiation that have allowed the children to be followed for less than 5 yr are not on a par with studies of cancer deaths before 10 yr of age, and why A-bomb survivors are in a class by themselves. The mistaken diagnoses do not account for the extra x-rayed cases in the Oxford survey. The age distributions and cell types of these cases suggest that they are a direct consequence of radiation-induced mutations, and may be the only numerically important group of childhood cancers to be caused by an external agent. (auth)

24933 COMMENTS ON "THE CARCINOGENIC EFFECTS OF LOW LEVEL RADIATION. A re-appraisal of epidemiologists methods and observations". Jablon, S. (National Research Council, Washington, DC). Health Phys.; 24: No. 2, 257-258 (Feb 1973).

The shortcomings of epidemiological surveys of the carcinogenic effects of irradiation in general are mentioned and the results of the Oxford survey (Stewart. Health Phys.; 24: 223-240 (1973)) are considered in particular. It is stated that Dr. Stewart has attempted to demonstrate that all surveys which in any way contradict the Oxford results are in error. Specific comment is made on Dr. Stewart's points concerning the Atomic Bomb Casualty Commission studies. It is maintained that contrary to Dr. Stewart's statements the population considered could in no way be considered normal and in fact the rise in deaths is a logical extension of the increased morbidity affecting particularly the old and the sick. Discrepancies in numbers given by Dr. Stewart of cancers among the Japanese children are also commented upon and it is concluded that since the number of deaths in the high dose group is not large, any estimate of relative risk will have a wide confidence interval so perhaps no more exact conclusion is possible than that these children have had their cancer risk elevated several fold, no matter what basis of comparison is used. (UK)

Vertebrates

Refer also to abstracts 24847, 24855, 24872, 25013, and 25020.

24934 (AD-749348) RESPIRATORY CONTROL AND SWELLING IN RAT LIVER MITOCHONDRIA: EFFECT OF ^{60}Co GAMMA RADIATION AND INJECTED NUTRIENT. Skidmore, W. D. (Armed Forces Radiobiology Research Inst., Bethesda, MD). Jun 1972. 18p. (AFRRI-SR-72-11). NTIS.

The relative effects of three treatments were compared with that of radiation on the lag time for mitochondrial swelling and the respiratory control during oxidation of succinate. The three treatments were dietary supplementation with ethyl linoleate, time of feeding, and an intraperitoneal injection of a solubie diet. Control and experimental rats from each of the eight different treatment groups were bilaterally exposed to 1000 rads of ^{60}Co gamma rays. Liver mitochondria were collected from the 16 different groups 24 hours later for assay. Iron-induced mitochondrial swelling was used as an index of structural integrity. Respiratory control of adenosine diphosphate stimulated oxidation of succinate was selected as an index of functional integrity. Results indicate that the intraperitoneal injection of a soluble diet significantly increased the lag time for swelling in every group given the injection in comparison with uninjected controls. The effect of radiation that tends to decrease the lag time is reversed by the dominant effect of the injection. In the assay for respiratory control, either whole-body irradiation or injection of a soluble diet significantly increased the respiratory control values above those for untreated controls. The significant effects were consistently observed in all treated groups. A direct and injurious effect of irradiation was not found in rat liver mitochondria. (auth) (NTIS)

24935 (AD-750681) BLOOD PO2 AND pH IN MONKEYS AFTER INCAPACITATING DOSES OF IONIZING RADIATION. Thorp, J W. (Armed Forces Radiobiology Research Inst., Bethesda, MD). Jun 1972. 18p. (AFRRI-TN-72-3). NTIS.

Aortic blood PO_2 and pH and internal jugular blood PO_2 were measured continuously in monkeys (Macaca mulatta) that received a 3000-rad midline tissue dose pulse of mixed gamma-neutron radiation. Immediately after irradiation the aortic blood PO_2 and pH increased slightly (5 to 10 torr and 0.05 pH unit, respectively); these changes were consistent with earlier reports that monkeys hyperventilated after similar irradiation. Venous blood PO_2 did not change after irradiation. Lack of oxygen in the blood did not contribute to radioinduced early transient incapacitation (ETI). If brain hypoxia does cause ETI, it must result from inadequate blood supply to all or part of the brain. (auth)

24936 (CEA-CONF-2157) EVOLUTION IN THE RAT OF THE PLASMA LEVELS OF ALPHA-AMINO-BUTYRIC ACID, VALINE, LEUCINE, AND ISOLEUCINE FOLLOWING SUB-LETHAL EXPOSURE TO ^{60}Co RADIATION. Its Usefulness for Dosimetric Purposes. Valle, C.; Breuil, L.; Pasquier, C. (Commissariat a l'Energie Atomique, Fontenay-Aux-Roses (France). Centre d'Etudes Nucleaires). [nd]. 13p. (In French). (CONF-720981-2). Dep. NTIS (U. S. Sales Only).

From 9th annual meeting of the European Society for Radiation Biology; Rome, Italy (26 Sep 1972).

Studies on rats showed a significant increase in amino acid levels in the blood plasma following exposure to sub-lethal doses of γ radiation. The content of α-aminobutyric acid, valine, leucine, and isoleucine in plasma was increased about 50% following exposure to whole-body doses ranging from 550 to 750 rads. A dose-response relationship was observed for the content of valine, with the optimum increase observed on the seventh day following exposure. The possibility of the use of plasma amino acid content as a biological dosimeter for humans exposed to 550 to 750 rads is suggested. (CH)

24937 (ORNL-4848, pp 45-48) RADIATION EFFECTS IN TERRESTRIAL ECOSYSTEMS. Feb 1973.

In Environmental Sciences Division annual progress report for period ending September 30, 1972.

Progress is reported on the following research projects: effects of simulated fallout radiation deposits on pollen viability in ^{137}Cs grassland facility; radial growth of Pinus echinata around unshielded reactor; effects of gamma radiation on excretion of ^{60}Co and ^{54}Mn in natural population of pine voles; effects of simulated radioactive fallout on arthropod community composition; effects of gamma radiation and $^{90}Sr-^{90}Y$ beta radiation on population dynamics, juveniles, and eggs of Sinella curviseta; and ^{137}Cs dose to invertebrates in grassland habitat. (HLW)

24938 (SZS-147) CHANGES OF DEOXYRIBOSIDE EXCRETION AFTER X-IRRADIATION IN RATS. Solle, M.; Bertram, R.; Geiss, C.; Orban, U.; Ogorek, C. (Staatliche Zentrale fuer Strahlenschutz, Berlin (East Germany)). Nov 1972. 27p. (In German). Dep. NTIS (U.S. Sales Only) $3.50.

Data are presented on the deoxyriboside excretion in rats after single whole-body, fractionated whole-body, and single partial-body x-irradiation. From single irradiation with doses between 10 and 900 R a dose-effect curve was obtained for total deoxyribosides as well as the deoxycytidine and the thymidine fraction. Furthermore, the normal values of the four pyrimidine deoxyribosides as well as the values caused by 900 R were determined. With fractionated irradiation (3×50 R, 2 or 3×100 R, and 100 + 200 + 300 R) the increase of deoxyriboside excretion declined from exposure to exposure. From the results conclusions are drawn with regard to repair processes. The irradiation of liver, spleen, intestine and hind legs with 950 R led to a 2- to 3-fold increase of urinary deoxyribosides with the exception of liver irradiation. The strongest effect was observed after irradiation of the hind legs. The results are discussed with regard to the use of deoxyriboside determination as an indicator of radiation damage. (auth)

24939 SEX RATIOS AND RETARDATION OF GONADAL DEVELOPMENT IN CHRONICALLY GAMMA-IRRADIATED CHINOOK SALMON SMOLTS. Bonham, K.; Donaldson, L. R. (Univ. of Washington, Seattle). Trans. Amer. Fish. Soc.; 101: No. 3, 428-434(Jul 1972). (RLO-2225-Ts-4).

The gonads of 4,405 premigratory smolts from eight year classes of chinook salmon, Oncorhynchus tshawytscha (Walbaum), were inspected to determine sex. Nearly half of the smolts of seven of the year classes had been irradiated for their first 80 days of life by exposure to the gamma rays of cobalt-60 at rates that increased almost exponentially from 0.5 R/day the first year to a maximum of 50 R/day the last year. Sex ratios were unaffected by 5 R/day or less, but at 10 or more R/day gonadal development was retarded. (auth)

24940 COMPARATIVE EXPERIMENTAL EVALUATION OF ONE- AND TWO-ROW SUTURE IN CLOSING INTESTINAL FISTULAS UNDER THE CONDITIONS OF ACUTE RADIATION SICKNESS. Sankov, N.; Vasilev, N.; Kiranov, I. Voenno Med. Delo; 27: No. 2, 15-18(1972). (In Bulgarian).

A comparison is made of the results from closure of artificially formed intestinal fistulas in 24 dogs, subjected to x irradiation with a total dose of 350 R. Two ways of suturing the intestinal wall are used, one-row and two-row, in the latent period and at the climax of the radiation sickness. An evaluation is made of the advantages of the one-row over the two-row suture, namely: more rapid performance, lesser traumatism, better haemostasis, acceleration of the regenerative processes, smaller number of postoperative complications, and lower lethality. (Abstr. Bulg. Sci. Med. Lit.)

24941 EFFECT OF RNA AND ITS HYDROLYZATES ON LIVER NUCLEIC ACID METABOLISM IN RADIATION INJURY. Tsudzevych, B. O. Visn. Kiiv. Univ., Ser. Biol.; No. 14, 13-17(1972). (In Ukrainian).

It was established that whole-body x irradiation of guinea pigs in a dose of 500 R causes significant disturbances in the content and renewal rate of the phosphorus of liver nucleic acids. Yeast RNA and its alkaline hydrolyzates promote normalization of the content and rate of renewal of the phosphorus of liver nucleic acids of irradiated guinea pigs. With the administration of yeast RNA, the lifespan of guinea pigs after irradiation is increased up to 15 to 25 days. Control animals, as a rule, die in 10 to 12 days. (JPRS)

24942 DOSE MEASUREMENT IN ANIMAL EXPERIMENTS. III. Dose distribution in ^{60}Co irradiated dogs. Novotny, J.; Mika, J.; Otoupal, P.; Hrusovsky, J. (Dept. of Dosimetry, Prague). Strahlentherapie; 144: No. 6, 737-741(Dec 1972).

Doses absorbed at 36 points of ^{60}Co irradiated dog cadavers were measured using LiF TLD. The homogeneity of the irradiation in the animals measured was found for small, medium and large dogs to be 1.38; 1.42 and 1.74 respectively, using a multilateral irradiation technique. The homogeneity of irradiation for large dogs was found to be moderately uniform according to ICRU classification using a combination of multilateral and bilateral irradiation techniques. (auth)

24943 ACCELERATED REGENERATION OF HAEMATOPOIETIC STEM CELLS AFTER IRRADIATION IN MICE PRETREATED WITH HYPOXIA. Beran, M. (Karolinska Institutet, Stockholm). Strahlentherapie; 144: No. 6, 719-727(Dec 1972).

Results are reported showing an increased number of endogenous splenic colonies in hypoxia pretreated mice (HP) irradiated within two days after hypoxia. This effect apparently does not result from an increase in the cell radioresistance and the data indicate that some mechanism exists by which the hypoxia preconditioning improves the regeneration of colony forming units (CFU). Indeed, an accelerated recovery of the endogenous repopulating potential was demonstrated in HP mice. The experiments that showed accelerated repopulation of CFU transplanted into HP lethally irradiated hosts suggest that this effect is probably unrelated to the conditioning of CFUs by hypoxia and is rather a result of an improvement in either the local environment for CFUs proliferation or a result of general metabolical changes after hypoxia which among others contribute to the improvement of the early steps of CFUs regeneration. A very short time is necessary for induction of observed changes and the possibility that an earlier resumption of CFU proliferation occurs was studied by the use of vinblastine. The preliminary results are discussed. (auth)

24944 IN VITRO CONTRACTILITY OF RAT SEMINIFEROUS TUBULES FOLLOWING 400 R WHOLE-BODY X IRRADIATION. Kormano, M.; Hovatta, O. (Univ. of Helsinki). Strahlentherapie; 144: No. 6, 713-718(Dec 1972).

Whole-body x-irradiation of 400 R was used to induce depletion of the spermatogenic epithelium in the testes of adult rats. In spite of the absence of active spermatogenesis, the myoid cells within the boundary tissue of the seminiferous tubules were found to maintain normal contractility. Irradiation damage caused no changes in histochemically demonstrable phosphatase activities of the boundary tissue. It was concluded that the function of the myoid cell layer is highly independent of the integrity of the spermatogenic epithelium, but influenced by the Leydig cell hormones. (auth)

24945 RADIATION EFFECTS ON PARENCHYMAL CELLS OF RAT LIVER. Suzuki, S.; Tsubouchi, S.; Matsuzawa, T. (Aichi Cancer Center, Nagoya, Japan). Gann; 63: No. 3, 345-352(Jun 1972).

The effect of x-irradiation on the liver of adult rats was studied. Parenchymal cell nuclei of the liver were microscopically distinguished from other littoral cell nuclei on smeared slides of isolated nuclei prepared in citric acid solution. Population analysis of parenchymal cells in the regenerating liver was made. An increase in parenchymal cells after partial hepatectomy was stepwise and suggested partially synchronous proliferation of the cells. The generation time and doubling time of the parenchymal cells calculated from the size of synchronous population and the growth curve were 36 and 67 hr, respectively. X-irradiation on upper abdomen of rats was carried out 24 hr prior to partial hepatectomy. The dose dependent delay of the parenchymal cell proliferation was observed. The surviving fraction of irradiated parenchymal cells was assayed from the growth curve after partial hepatectomy. Parameters of radiation sensitivity, D_0, D_q, and extrapolation number were calculated as 250, 500 rads, and 7.5, respectively. (auth)

24946 MUTAGENIC EFFECT OF DIFFERENT TYPES OF IRRADIATION ON THE GERM CELLS OF MALE MICE. VII. The effect of dose-rate of gamma irradiation on the induction of reciprocal translocations in spermatogonia. Pomerantseva, M. D.; Ramaiya, L. K.; Ivanov, V. N. (Inst. of General Genetics, Moscow). Genetika; 8: No. 12, 128-134(Dec 1972). (In Russian).

The frequency of reciprocal translocations induced in mouse spermatogonia by different doses (300 to 1200 R) of gamma-irradiation over a range of 0.007 : 0.07 : 710 R/min was investigated. At the dose-rate of 0.007 R/min (10 R/day) the yield of reciprocal translocations was about $1/3$ of the yield at the acute irradiation (710 R/min). The frequency of translocations at the dose-rate (0.07 R/min) was below the translocations yield at the acute treatment and higher than that at the 0.007 R/min. The reduction of the dose-rate from 0.007 to 0.0035 R/min did not change the aberration frequency at 600 R. At all levels of dose-rates used, no increase of the translocations yield was observed if the dose was above 600 R. When the acute dose of 900 R was given in 3 fractions of 300 R separated by 28 day intervals the aberration frequency was higher than that obtained at the same single dose. The influence of selective cell death and repair on dose-effect curves of induced translocations is discussed. (auth)

24947 LATE EFFECT OF RADIATION ON THE HAEMOPOIETIC STEM CELLS OF THE MOUSE. Covelli, V.; Metalli,

P. (Comitato Nazionale per l'Energia Nucleare, Casaccia, Italy). Int. J. Radiat. Biol.; 23: No. 1, 83-89(Jan 1973).

The number of nucleated cells and the proportion of colony-forming units (CFU) were estimated in the femoral marrow of $(C57B1\times C3H)F_1$ male mice aged 20 months or more, and of mice of the same age surviving a mid-lethal dose of x-rays delivered when young adults. Both total cellularity and CFU's were found to be decreased by previous irradiation compared with controls of comparable age. These parameters were also found to be slightly age-dependent in normal mice but not those that had been irradiated. Particular attention was paid to the histopathology of haemopoietic organs of the aging mice: donor animals in which reticular tissue tumors were found, even in early stages, were excluded. Results are discussed mainly in terms of residual radiation injury. (auth)

24948 HISTOMORPHOLOGY OF THE REPARATORY PROCESS IN INTESTINAL ANASTOMOSES WITH ONE- AND TWO-STOREY SUTURE IN RADIATION SICKNESS. Nakov, E.; Daaliev, S. Voenno Med. Delo; 26: No. 6, 11-16(1971). (In Bulgarian).

The effects of radiation sickness on the time required for the repair of surgical incisions of the intestine of dogs were studied. The animals were exposed to a whole-body dose of 435 R and surgical resection of the ileum was performed 24 hours later. The suturing technique employed had a greater effect on the recovery time than did radiation sickness. (CH)

24949 RENAL TUMORS IN PARABIOSED IRRADIATED RATS. Warren, S.; Brown, C. E.; Porter, W. M. (New England Deaconess Hospital, Boston). Radiat. Res.; 53: No. 1, 153-163 (Jan 1973).

Ninety-five (7.6%) irradiated partners of 1244 parabiosed rats receiving 1000 R of whole-body irradiation developed renal tumors, 10.3% of the males and 5.2% of the females. The commonest types of renal tumors were renal cell carcinomas, adenomas, and transitional cell carcinomas. As with irradiation carcinogenesis in general, renal tumors in irradiated rats appear earlier and with greater frequency than spontaneous tumors in nonirradiated rats. The nonneoplastic renal tubular epithelium of the irradiated tumor-bearing kidneys contained fewer mitoses than the renal tubular epithelium of their nonirradiated partners. (auth)

24950 DIFFERENTIAL ACCUMULATION OF LIPOFUSCIN PIGMENT IN CEREBRAL CORTEX OF RAT. A Quantitative and Morphological Study with Age After Prenatal X Radiation. Brizzee, K. R.; Cancilla, P. A. (Tulane Univ., Covington, La.). Contract AT(40-1)-3832. Gerontologia; 18: 1-13(1972).

A comparison of the amount and distribution of lipofuscin pigment in neurons of cerebral cortex in prenatally x-irradiated (90R) and control aged rats was carried out in areas 3 and 17. The proportion of the neuron somata occupied by the pigment bodies, as determined through the application of the random-hit principle in phase-fluorescence microscope studies, was not significantly different in irradiated and control brains in either cortical area. However, the amount of pigment was greater in neurons of area 3 than those of area 17 in both irradiated and control animals. Ultrastructural studies of cerebral cortical tissues in area 3 revealed no abnormalities in neurons or glia of irradiated as compared with control rats. (auth)

24951 STIMULATION OF HEMATOPOIESIS BY FEMORAL MARROW CURETTAGE IN SUBLETHALLY IRRADIATED MICE. Knospe, W. H.; Gregory, S. A.; Fried, W.; Trobaugh, F. E. Jr. (Abraham Lincoln School of Medicine, Chicago). Blood; 41: No. 4, 519-527(Apr 1973).

Femoral bone marrow curettage produced an intense stimulus on hematopoietic stem cells (HSC) in sublethally irradiated mice 4 days after curettage. A similar but lesser stimulation of ^{59}Fe incorporation into spleen and red cells was observed. Previous investigations showed that this effect is not observed in unirradiated mice. Histologic studies of the curetted femurs indicated a rapid regeneration of a primitive mesenchymal tissue within the medullary cavities during the period of stimulation. It is suggested that the primitive mesenchymal cells synthesize a humoral factor that is capable of stimulating HSC in a marrow microenvironment of depleted cellularity. The observations are consistent with a hypothesis of inhibition of HSC response to a similar stimulus in a normocellular marrow by a mechanism of cell-cell interaction. The humoral factor affects HSC similar to fetuin, spleen extract, and alpha globulin fractions. (auth)

24952 EFFECT OF DIVIDED DOSES OF X-RAYS ON THE REGROWTH OF HAIR IN THE MOUSE. Burlin, T. E.; Challoner, A. V. J.; Magnus, I. A.; Szur, L. (St. John's Hospital for Diseases of the Skin, London). Int. J. Radiat. Biol.; 23: No. 2, 121-131(Feb 1973).

In radiotherapy, the time interval between successive treatments varies between one and fourteen days. A study of the effect of such time intervals between doses of x rays was undertaken on the mouse hair follicle. The regrowth of the hair after irradiation is used as an index of the biological effect of the radiation. The magnitude of the second dose of a split-dose treatment producing the same biological effect as a single dose generally increased with the time interval between doses, but had a maximum value when the time interval was four days. Possible reasons for this effect and its significance are discussed. (auth)

24953 EXPERIMENTAL STUDIES ON PROTEIN LOSS INTO THE INTESTINE FOLLOWING ABDOMINAL IRRADIATION IN RATS. Kuraoka, T. (Kagoshima Univ., Japan). Kagoshima Daigaku Igaku Zasshi; 21: No. 1, 9-34(Jun 1972). (In Japanese).

A series of experiments were performed in order to investigate the effects of abdominal irradiation on the amount of serum proteins, mechanism of protein loss in the intestine under different mode of irradiation, i.e., single dose, fractionation, and split course irradiation, and on the histological change in intestinal mucosa. Female rats were irradiated with 250 KVP, 20A in the dose rate of 80R/min in the air, 1.0 mm Cu, and 1.0 mm Al filters and 50 cm target-skin distance. ^{131}I-labelled P.V.P. (polyvinylpyrrolidone) was used for determination of enteric protein loss. Marked decrease in serum protein following single dose irradiation (600 R and 1000 R) was observed on the fourth day to recover thereafter, causing hypoproteinemia as irradiation dose was increased. The amount of enteric protein loss was proportional to irradiation dose, thus indicating close correlation with the incidence of hypoproteinemia. With fractionated irradiation (10-day period in the total dose of 1000 R), enteric protein loss reached highest on the first day after completion of irradiation and gradually decreased thereafter. No marked difference in protein loss was observed in split-course irradiation group, suggesting certain recovery in interval. Observation on the histological changes in the intestinal mucosa indicates the mechanism of enteric protein loss: atrophy of villi, enlarged crypts and atrophy of crypt cells, swelling or destruction of epithelial cells were marked in single dose irradiation groups, while such cellular disorders were relatively minor in the fractionated and split-course irradiation groups with characteristic findings in dilated lymphatics in the submucosa. (Japan)

24954 EARLY CHANGES OF POTASSIUM AND SODIUM LEVELS IN ERYTHROCYTES AND PLASMA AFTER γ-IRRADIATION OF MICE. Harlamova, H. (Inst. of Experimental Biology, Tallin). Izv. Akad. Nauk Est. SSR, Ser. Biol.; 20: No. 3, 215-220(1971). (In Estonian).

Irradiation of mice with ^{60}Co γ rays at 700 to 1000 R caused no significant changes in the potassium and sodium levels in blood plasma. Potassium levels in erythrocytes decreased by 6 to 11.6% in 2 hrs and increased by 13 to 20.8% in 2 days following irradiation. Sodium levels in erythrocytes increased by 31 to 50% in 2 hrs and decreased by 10.4 to 12.4% in 2 days following irradiation. The observed changes were not the direct result of the effects of γ radiation on the erythrocyte membrane, but were due to secondary factors such as radiotoxins or hormonal changes. (ERB)

24955 MORPHOLOGICAL CHANGES IN TRANSPLANTABLE GUERIN EPITHELIOMA TREATED WITH X-RAYS AND TRIAZIQUONE. II. THE EXTENT OF NECROTIC CHANGES AND THE MITOTIC INDEX. Zebro, T.; Falkowski, J.; Papla, B.; Szczudrawa, J. (Academy of Medicine, Krakow). Patol. Pol.; 22: No. 2, 201-209(1971). (In Polish).

Increased necrosis of tumor tissue and increased mitosis were observed four days after x irradiation (1000 R) of rats with transplantable Guerin epithelioma. Depending on which of these trends predominated, growth or reduction of the tumor occurred. Necrotic changes were stimulated by combined x-ray and triaziquone therapy. (ERB)

24956 EFFECT OF 180 MeV PROTON OR ^{60}Co GAMMA RADIATION ON THE INCORPORATION OF ^{125}I-IODO-2'-DEOXYURIDINE INTO INTESTINAL AND SPLENIC DEOXYRIBONUCLEIC ACID OF MICE. Johanson, K. J.; Larsson, B. (Univ. of Uppsala). Acta Radiol., Ther., Phys., Biol.; 11: No. 5, 452-464(Oct 1972).

The incorporation of ^{125}Iododeoxyuridine into the intestinal and splenic DNA of mice was investigated by biochemical and autoradiographic methods after ^{60}Co gamma and 180-MeV proton irradiation. $^{125}IUdR$ proved to be a specific precursor for DNA. A marked decrease occurred similar to the results obtained by biochemical and autoradiographic techniques. (auth)

24957 GROWTH INHIBITION IN RANA PIPIENS DUE TO SPERM IRRADIATION WITH ULTRAVIOLET RAYS. Pogany, G. C. (Northern Arizona Univ., Flagstaff). J. Exp. Zool.; 183: No. 1, 121-137(Jan 1973).

When sperm are irradiated for periods varying from 5 to 120 seconds at 31 ergs/mm^2, then allowed to fertilize untreated eggs, the ensuing embryos display distinct growth inhibition. The degree of growth inhibition is not proportional to the exposure; this is indicated by the condition observed in the five second embryos where growth is most retarded and abnormal. Cells in the irradiated embryos are shown to be smaller than the control. A possible mechanism for this reduced cell size is proposed based on the theory that chromosomes replicate in some linear fashion. It is also proposed that the abnormalities found in embryos subjected for five seconds be used to detect small radiation damages in other organisms. (auth)

24958 LITTER SIZE INCREASES IN THE X-IRRADIATED HAMSTER AND ITS RELATIONSHIP TO DOSE. Hahn, E. W. (Sloan Kettering Inst., New York). Lab. Anim. Sci.; 22: No. 5, 649-651(Oct 1972).

The number of ovulations, implantations, and term fetuses were determined in the Syrian hamster exposed to levels of x-irradiation (10 to 600 R wholebody) 3 to 4 days prior to mating. Exposures of 25, 50, and 100 through 400 R significantly increased the average number of ova shed, with no increase observed at 75 R. Similarly, 25 and 50 R and 200 to 400 R significantly increased average implantation rates, but average litter size was significantly increased to 15.0 and 14.8 only at 25 and 50 R, respectively. (auth)

24959 RADIATION-RESISTANT THYMIC STEM CELLS. Kubai, L.; Auerbach, R. (Univ. of Wisconsin, Madison). Proc. Soc. Exp. Biol. Med.; 142: No. 2, 554-559(Feb 1973).

Thymus rudiments obtained from 12 to 13 day mouse embryos were irradiated with 250, 500 or 1000 R x rays and their subsequent morphogenesis studied both in vitro and by transplantation into irradiated host animals. Although irradiation had a marked effect on total growth of rudiments, the differentiation of lymphoid cells did not appear to be inhibited. Both on the basis of morphology in histological preparations and by size analysis, lymphocytes formed after irradiation were indistinguishable from lymphocytes produced by unirradiated rudiments. The results suggest that a significant portion of lymphoid precursor cells of the early embryonic rudiment of the thymus are radiation resistant. (auth)

24960 VIRUS PARTICLES IN RELATION TO RADIATION-INDUCED CHANGES IN THE THYMUS OF C_3H MICE. Jaerplid, B. (Foersvarets Forskningsanstalt, Stockholm). Acta Radiol., Ther., Phys., Biol.; 11: No. 5, 422-432(Oct 1972).

The occurrence of virus particles in the thymus after fractionated, leukemogenic irradiation was investigated in respect of the various phases of the thymic regeneration. The significance of virus particles for the induction of thymic lymphoma was discussed. (auth)

24961 INVOLUTION AND RECOVERY OF THE THYMUS AND SPLEEN OF THE MONGOLIAN GERBIL FOLLOWING ROENTGEN IRRADIATION. Montour, J. L.; Riley, R. C. (Virginia Commonwealth Univ., Richmond). Acta Radiol., Ther., Phys., Biol.; 11: No. 5, 481-489(Oct 1972).

Young male gerbils were exposed to 100 R to 1,600 R. Thymic and splenic weight were determined 1, 2, 3, 5, 8, and 14 days after exposure. Although the rate of involution of these organs appeared to be independent of dose, the degree of weight loss was directly related to dose. Maximum weight loss compared to dose was found to be a two component function for both organs. The sensitive component in each case had an ED_{50} (50% weight loss) of 50 R, similar to that for the same component in mice. The second, or insensitive, components were much more resistant than the comparable components in mice, yielding ED_{50} values of 560 R (thymus) and 2,060 R (spleen). (auth)

24962 PECULIARITIES OF CLONING OF STEM CELLS OF RATE GENOTYPE IN THE SPLEEN OF LETHALLY IRRADIATED MICE. Koval'chuk, L. V.; Khaitov, R. M.; Shvets, V. N. (Inst. of Biophysics, Moscow). Tsitolgiya; 15: No. 1, 90-96(Jan 1973). (In Russian).

Mice (CBA × C57BL)F_1 irradiated at lethal dose (850 R) were grafted with graduated doses (from $0.12 \cdot 10^6$ to 2.10^6) of bone marrow cells from the Wistar rats. Recipients were sacrificed on the 10th day, and the number of spleen colonies was counted. The genotype of colonies was determined by chromosomal analysis. It was demonstrated that spleen colonies had the donor's origin. However, a high number of endogenous colonies was registered in mice in the presence of colonies of rat genotype. Rat stem cells had a low proliferative activity in the body of mice, which was completely abolished by mouse lymphocytes. Colonies of erythroid type were predominantely formed in the spleen of xenogeneic chimerae. The ratio of erythroid to granuloid colonies was equal to 5.4 : 1.0. Rat stem cells have already lost their self-maintaining function after the first passage through the body of mice. (auth)

24963 PNEUMOPATHY OF IONIZING RADIATIONS IN RATS TREATED WITH A COMPLETE FREUND ADJUVANT: HISTOLOGICAL EXHIBITS. Mancini, A. M.; Massarelli, C.; Bompiani, C.; Cattogno, P.; Vecchi, A. (Univ., Sassari, Italy). Nunt. Radiol.; 35: No. 8, 715-730(Aug 1969). (In Italian).

The effects of complete Freund adjuvant on lung lesions following gamma irradiation of one hemithorax were determined in a number of rats that were given the adjuvant before or after irradiation. In the group of rats that were given the adjuvant before irradiation, the initial picture was one of intense inter-alveolar wall inflammation and congestion, with desquamating alveolitis and bronchial lymph node activation, as evidenced by a high number of serum cells and by lymphocytic muffs around blood vessels. Later, an early wall fibrosis was noted and, while congestion disappeared, the prevailingly plasmacellular interstitial infiltration persisted. In the group of rats that were given the adjuvant after irradiation, the initial lung picture was about the same observed in the former group, but later on perivascular inflammation persisted and became even heavier, and intra-alveolar desquamation was observed, with a fibrin-rich, dense, sometimes hyalin-like exudate. Stromal fibrosis followed the same course as in the former group of rats. It was suggested that in the first group the adjuvant aggravated irradiation-caused lesions, while in the latter they stimulated the auto-immunization processes against epithelial antigens released by irradiation. (auth)

24964 STRUCTURE CHROMOSOME MUTATIONS IN BONE MARROW CELLS OF MONKEYS IN DISTANT TERMS AFTER REPEATED LONG-TERM IRRADIATION. Kosichenko, L. P. (Inst. of Experimental Pathology and Therapy, Sukhumi, USSR). Genetika; 9: No. 1, 134-142(Jan 1973). (In Russian).

The % of chromosome mutations in bone marrow cells at distant times (4, 6, and 8.5 yrs) after the cessation of long term gamma irradiation (2.99 to 4.9 R per day) is higher than in the control. Individual differences in the cytogenetic after-effect of radiation were noted in the irradiated animals. Aberrations of the metabolic type dominated in all total radiation doses: 826 R, 1208 R, 1600 R, and 3677 R. New cell clones marked by abnormal chromosomes in easily identified pairs: 1; 19; 20 etc. were detected. The frequency of aneuploid cells presented in the experimental as well as control animals is considered to be an artefact. (auth)

24965 LENS CHANGES IN THE RABBIT FROM FRACTIONATED X-RAY AND PROTON IRRADIATIONS. Cleary, S. F.; Geeraets, W. J.; Williams, R. C.; Mueller, H. A.; Ham, W. T. (Medical Coll. of Virginia, Richmond). Health Phys.; 24: No. 3, 269-276(Mar 1973).

Opacification of the rabbit lens was studied as a function of dose and time post irradiation for single and fractionated doses of 1 MeV x rays, 20 and 100 MeV protons. The degree of opacification was found to be a function of time, radiation dose, LET, and mode of dose deliverance. Fractionation reduced the final degree of lens opacification by a factor of 2 or less, depending on the dose and type of radiation. (auth)

24966 GNATHO RADIO NECROSIS. Experimental studies in rats. Abusinna, I. M. Salonika, GR; Aristolelian Univ. of Salonika (1972). 144p. (In Greek).

Thesis.

The term Gnatho Radio Necrosis with abbreviation (G.R.N) was introduced to denote jawbone radio necrosis. The term was introduced to distinguish the jawbone radionecrosis from other osteoradionecrosis occurring in other bones in different regions of the body, such as osteoradionecrosis of femur or ribs. Although each is referred to as radionecrosis, the underlying mechanisms, the management, prophylaxis, treatment, and prognosis differ widely. The problem of the Stomato Gnathic Radio Necrosis (S.G.R.N.), as a whole, and the problem of the Gnatho Radio Necrosis (G.R.N.), were studied in all their manifold aspects. (auth)

24967 CYTOSPECTROPHOTOMETRICAL AND MORPHOLOGICAL DATA ON THE EFFECT OF IONIZING RADIATION UPON THE MAMMARY GLAND. Rudakov, V. V.; Shaviaev, Z. F. Arkh. Anat., Gistol. Embriol.; 63: No. 10, 21-27(Oct 1972). (In Russian).

Morphological picture of the lactating mammary glands was studied in goats and albino rats under normal conditions and after irradiation. RNA and protein contents were determined cytospectrophotometrically in the glandular cells after exposure to ionizing radiation. No changes were found in the general structure of the gland in goats within the first hours after local irradiation of the gland at 5000 R. RNA content was not considerably changed but the amount of protein increased considerably. During radiation disease resulting from general irradiation of rats (1000 R) the morphology of the mammary gland had pronounced lesions:

destruction and degeneration of cells, alveoli, and glandular lobes. RNA contents in the cell decreased. The data obtained show no lesions in the cell structure responsible for protein biosynthesis immediately after irradiation. The changes observed during radiation disease seem to be secondary. (auth)

24968 CHANGES OF THE ALKALINE PHOSPHATASE, GLUTAMINE OXALACETIC ACID TRANSAMINASE, AND LIPID FRACTION OF THE SERUM AND LIVER IN RATS AFTER LOCAL IRRADIATION OF THE LIVER WITH 8000 R. Bathori, E.; Gottwald, G.; Soltesz, L. (Medical Radiology Research Group, Budapest). Radiobiol.-Radiother.; 14: No. 1, 79-87(1973). (In German).

The changes of the alkaline phosphatase of the serum and of the liver of the GOT-activity as well as of the total cholesterin, of phospholipid and fatty acid ester concentrations after 8000 R of local x irradiation of the liver of rats were examined. During the examination, the alkaline phosphatase in the serum decreased; that in the liver, however, increased. The GOT-activity in the serum decreased from the 5th to the 10th day, a decrease in the liver was also found from the 3rd to the 10th day. In the lipid fractions, there was a significant change in the total cholesterin fraction of the liver only. The fraction to a low extent decreased from the 3rd to the 10th day. (auth)

24969 WITHDRAWAL OF CYSTAMINE AND ITS METABOLITES FROM THE ORGANISM OF IRRADIATED AND NON-IRRADIATED MICE. Pavlova, L. M.; Bondarev, N. N.; Sverdlov, A. G.; Grachev, S. A.; Saikova, V. A.; Mus, G. I. (Ioffe Inst. of Physics and Tech., Leningrad). Vop. Med. Khim.; 19: No. 1, 22-25(1973). (In Russian).

The following compounds were found in mouse urine within 20 min after peritoneal injection of ^{35}S-cystamine: cystamine, cystamine disulphoxide, mixed cysteamine and cysteine disulphide, S-acetylcysteamine, taurine, hypotaurine, isothyenic acid, and sulphate ion. The content of these cystamine metabolites increased within 17 hrs after the injection. Under irradiation of mice and irradiation in mixed gamma-neutron field at minimal absolutely lethal doses, a decrease in the content of cystamine metabolites was observed. (auth)

24970 EFFECT OF 25-MeV ELECTRONS AND GAMMA RAYS ON THE ACTIVITY OF TRANSKETOLASE IN THE ANIMAL ORGANISM. Pikulev, A. T.; Orel, N. M. (Belorussian State Univ., Minsk). Dokl. Akad. Nauk BSSR; 17: No. 2, 179-181(Feb 1973). (In Russian).

The effect on trans-ketolase in the liver, kidneys, and spleen of a wistar strain of white rats of 25 MeV electrons and gamma radiation from ^{60}Co in 43 R doses was studied. Observations were conducted one hr, and 1, 3, 7, 15, and 30 days after irradiation. The results indicated that the 25 MeV electrons were less effective than γ radiation. The displacement in transketolase was the result of both direct and indirect effects of the ionizing radiation. (tr-auth)

24971 EFFECT OF X-RAYS ON THE DNA CONTENT OF THE GLIAL CELLS OF THE FROG'S NEUROHYPOPHYSIS. Gelashvili, N. A. (Inst. of Physiology, Tbilisi, USSR). Soobshch. Akad. Nauk Gruz. SSR; 69: No. 2, 433-436(Feb 1973). (In Russian).

A cytophotometric study of the DNA content in cell nuclei of the frog's neurohypophysis has shown that the effect of total irradiation by equal doses of ionization is more pronounced in animals whose hypophyses were activated by artificial light prior to irradiation, and especially in animals that were exposed in advance to the action of visible light and injected with a suspension of hypophysis. Thus, with a dose of 2000 R nuclei with an increased DNA content were noted. Exposure to a dose of 10,000 R resulted not only in an increase of the content of DNA but a statistically significant decrease in some glial cells of the neurohypophysis. (auth)

Invertebrates

24972 (AECL-3789) RADIATION DOSE TO MOSQUITO LARVAE REARED IN RADIOACTIVE MEDIA. Scott, A. G. (Atomic Energy of Canada Ltd., Pinawa (Manitoba). Whiteshell Nuclear Research Establishment). Nov 1972. 23p. Dep. NTIS (U.S. Sales Only) $3.25.

The biological effects on Aedes aegypti larvae reared in medium containing ^{90}Sr + ^{90}Y differ from those resulting from rearing in media containing the same concentration of ^{32}P. These differences are attributed to differing radiation doses. The average β dose-rate to each larval instar was calculated by Loevinger's sphere and cap method. The total dose received by larvae reared in either medium was estimated using measured values of radionuclide accumulation. The dose-rate to a larva reared in ^{90}Sr + ^{90}Y or ^{32}P solutions was mainly from the internally deposited nuclides. This varied from instar to instar, the greatest dose-rate from ^{32}P occurring during instar I, and from ^{90}Sr + ^{90}Y during instar IV. Thus different biological effects from the same total dose are to be expected. (auth)

24973 (COO-78-292) MOVEMENTS OF ECHINOCHROME PIGMENT GRANULES IN SEA URCHIN EMBRYOS. Belanger, A. M. (Case Western Reserve Univ., Cleveland, Ohio. Dept. of Biology). Jun 1973. Contract W-31-109-eng-78. 151p. Dep. NTIS $9.75.

Thesis.

A study was made of characteristic movements of echinochrome pigment granules in various stages of embryonic development of the sea urchin Arbacia punctulata. Particular emphasis was placed on clear area formation due to migration of pigment granules. Eggs were exposed to 50 to 250 kR γ radiation before or immediately after fertilization. No inhibition of granule movement was observed in unfertilized eggs 90 min after the end of irradiation. Migration of pigment granules to the cortex occurred at the normal time in eggs irradiated before fertilization. Cleavage was observed in some eggs irradiated with less than 200 kR before or after fertilization. At all dose levels clear areas appeared on undivided eggs as well as on those that were able to cleave. (HLW)

24974 (ORO-3862-2) EFFECTS AND MECHANISMS OF ACTION OF IONIZING RADIATION ON THE HOUSE FLY, MUSCA DOMESTICA L. Final Report, November 1, 1968-October 31, 1972. Rockstein, M. (Miami Univ., Coral Gables, Fla.). 15 Oct 1972. Contract AT(40-1)-3862. 19p. Dep. NTIS $3.00.

Eggs of the house fly were collected one hr after oviposition and x-irradiated in the Maxitron 250 at a dose rate of 444 rads per min. Although the percentage of emergence of larvae was significantly reduced, the actual mean longevities of males and females successfully reaching the adult stage were identical with those obtained from control eggs. Following irradiation of the pupae an increase in life span was observed as well as enhancement of the activity of enzyme systems concerned with energizing of flight, with the indication that the enhancement of the rate of protein synthesis by such radiation at an early point in the adult stage is one of the important mechanisms by which the flight ability of the male is extended and enhanced. Pupae of various ages were exposed to magnetic fields; no differences were observed between experimental and control flies with regard to mean longevities. (HLW)

24975 EFFECTS OF GAMMA RADIATION ON THE FERTILITY OF THE SPIDER MITE TETRANYCHUS ARABICUS ATTIAH. Wakid, A. M.; Elbadry, E. A.; Elaal, M. A. (Ain Shams Univ., Cairo). Ann. Zool.-Ecol. Anim.; 4: No. 3, 375-378(1972).

Male and female Tetranychus arabicus Attiah were sterilized at doses of 28 and 30 krad respectively. The fecundity of treated females mated to untreated males was affected by doses of 24 and 30 krad. The viability of eggs produced by treated mites was affected by doses of 16 and 30 krad. Doses ranging from 8 to 60 krad apparently induced dominant lethal mutations in the sperm. Doses of 80, 100, and 140 krad caused sperm injury or inactivation. Females mated to gamma irradiated males produced fewer female progeny and more nonviable eggs as the dosage of radiation increased. At a dosage of 28 krad, there were only male progeny. (auth)

24976 EFFECTS OF GAMMA RADIATION ON THE SPIDER MITE TETRANYCHUS ARABICUS ATTIAH. II. Irradiation of larvae. Wakid, A. M.; Elbadry, E. A.; Elaal, M. A. (Ain Shams Univ., Cairo). Ann. Zool.-Ecol. Anim.; 4: No. 3, 379-383(1972).

Effects of gamma radiation from ^{60}Co on newly hatched larvae of Tetranychus arabicus were determined. Irradiation of larvae resulted in reduced numbers and delayed and incomplete adult emergence. Fecundity of females resulting from irradiated larvae was reduced. Length of the life span of adults decreased appreciably following dose of 10 krad. Males were more sensitive than females to radiation injury. At 25 krad, male emergence was completely inhibited. At 30 krad, females did not lay eggs, however at 15 krad egg viability was reduced to 25 p. 100. (auth)

24977 ULTRASTRUCTURAL EXAMINATION OF AGEING AND RADIATION-INDUCED LIFE-SPAN SHORTENING IN ADULT DROSOPHILA MELANOGASTER. Gartner, L. P. (Univ of Maryland, Baltimore). Int. J. Radiat. Biol.; 23: No. 1, 23-39 (Jan 1973).

A Canton S strain of wild-type Drosophila melanogaster was exposed to 99,000 R of ^{60}Co gamma radiation at a very low dose-rate of 25 R/min. The mid-guts of the irradiated and control populations were examined at graded intervals of time to study any ultrastructural alterations that may occur both as a function of age and the radiation insult. The investigation demonstrated that radiation accelerated some of the age-related fine structural

alterations, but it was also responsible for changes not present in the control population. A theory of ageing, radiation-induced life-span shortening, and death, based on amelioration of cellular function, was proposed. (auth)

24978 PROTECTIVE EFFECT OF β-MERCAPTOETHYLAMINE AGAINST FAST NEUTRONS IN DRY EGGS OF ARTEMIA. Iwasaki, T. (National Inst. of Radiological Sciences, Chiba, Japan). Int. J. Radiat. Biol.; 23: No. 1, 95-97(Jan 1973).

A study was made of the hatchability of Artemia eggs treated with 2M MEA prior to irradiation with 2 MeV neutrons, over a dose range 0 to 100 krads. The results indicated a protective action by MEA against fast neutrons. A dose-reduction factor (DRF) of 1.2 was found by comparing the doses required to reduce hatchability to 50% in MEA treated and nontreated controls. (UK)

24979 EFFECT OF IRRADIATION ON THE EMBRYONIC AND POSTEMBRYONIC DEVELOPMENT OF AMIDOSTOMUM ANSERIS (ZEDER, 1800). Doan Van Phuc; Varga, I. (Univ. of Veterinary Science, Budapest). Acta Vet. Acad. Sci. Hung.; 22: No. 2, 197-203(26 Oct 1972). (In Hungarian).

Exposure of Amidostomum anseris eggs to various doses of gamma irradiation (between 5 and 160 kilorad) caused a dose-dependent deleterious effect on their development, involving a smaller percentage of eggs capable of completing segmentation and reaching the infective larval stage. The effect of irradiation on embryogenesis was similar to that for other nematode parasites of poultry. Irradiation of third-stage larvae at 80 krad rendered them non-infective. An exposure of about 40 krad may be necessary for attenuation in immunization experiments. (JPRS)

24980 STUDIES ON ERADICATION OF ANOPHELES PHAROENSIS THEOBALD BY THE STERILE MALE TECHNIQUE USING ^{60}Co. X. Biological Effects of Larval Labelling with ^{32}P on Different Characters related to fitness components. Wakid, A. M.; Tantawy, A. O.; Abdel-Malek, A. A. (Middle Eastern Regional Radioisotope Center for the Arab Countries, Cario). Isotope Radiat. Res.; 5: 27-30(Jun 1972).

Exposure of the third instar larvae of Anopheles pharoensis Theobald to different concentrations of ^{32}P showed significant decreases in egg production especially at high concentrations; at 2.0 μc^{32}P/ml no eggs were oviposited. There was a highly significant decline in percentage of egg hatchability at all concentrations used as compared with the controls. Generally, labeling with ^{32}P in the larval sage had no apparent effects on adult longevity. (auth)

Radionuclide Effects (Internal Source)

Man

Refer also to abstract 24593.

24981 (CONF-710563-3) RADIO DOSIMETRY OF ^{90}YTTRIUM, AND ITS DISTRIBUTION THROUGH THE BODY, FOLLOWING INJECTION IN THE KNEE. Gumpel, J. M.; Williams, E. D.; Glass, H. (Northwith Park Hospital, Harrow (England); Hammersmith Hospital, London (England). Medical Physics Dept.). 1971. 4p. Dep. NTIS (U. S. Sales Only).

From Meeting on radioisotope synoviotherapy (synoviomathesis); Paris, France (26 May 1971).

Quantitative methods were used to detect the bremsstrahlung emitted by ^{90}Y and found in various parts of the body after injection in the knee. Concentrations were usually found in the lymph nodes, although in one patient they were found in the liver in the absence of lymph node spread. (France)

24982 (KFK-1615) CALCULATION OF THE DOSE FACTOR FOR THE MOST IMPORTANT RADIONUCLIDES. Comper, W. (Kernforschungszentrum, Karlsruhe (West Germany)). Dec 1972. 38p. (In German). Dep. NTIS (U. S. Sales Only).

Methods used for calculating the radiation dose to bones, kidney, liver, lungs, spleen, and whole-body of man following the inhalation or ingestion of radionuclides are described. Dose factors were computed for some 100 radionuclides. The equations employed for the dose calculations and the simplified assumptions used are included. (CH)

24983 (STI/DOC-10/142) INHALATION RISKS FROM RADIOACTIVE CONTAMINANTS. REPORT OF A PANEL, VIENNA, 30 NOVEMBER–4 DECEMBER 1970. (International Atomic Energy Agency, Vienna (Austria)). Jan 1973. 146p. IAEA $5.00.

Separate abstracts were prepared on nine chapters. Two additional chapters discuss the physical properties of aerosols and the physiology of the normal respiratory tract. (CH)

For abstracts of individual chapters see: 24651, 24988–24990, 25021, 25031, 25032, 25059, and 25060.

24984 HEALTH PHYSICS PRACTICES IN LABORATORIES USING ^{3}H- AND ^{14}C-LABELED TRACERS. Berger, J. D.; Cloutier, R. J. (Oak Ridge Associated Universities, TN). Lipids; 7: No. 9, 604-610(Sep 1972).

Tritium and ^{14}C are often considered relatively safe radionuclides to handle because their permissible body-burdens are orders of magnitude greater than those for most radionuclides. This is reflected in the U. S. Atomic Energy Commission regulations that do not require a license for the use of amounts up to 1000 μCi of ^{3}H and 100 μCi of ^{14}C. Although many tracer studies are performed with much smaller quantities, poor control of even these small amounts can result in contamination, causing an internal radiation hazard or the loss of valuable experimental data. Methods of handling radioactive materials that minimize the risks of contamination are discussed with emphasis on the needs for proper storage, secondary containers, monitoring air and surfaces, and analysis of bioassay samples for measuring body burdens. The user's responsibilities for licensing, waste disposal, and transportation are also discussed. Experience at a laboratory handling both tracer and curie amounts of ^{14}C and ^{3}H required for labeling and synthesizing compounds and methods of accident prevention and decontamination are described. (auth)

24985 EFFECT OF INCORPORATED ^{226}Ra ON COLONY FORMING UNITS OF BONE MARROW AND SPLEEN IN MICE. Svoboda, V.; Klener, V. (Institut Hygieny a Epidemiologie, Prague). Acta Radiol., Ther., Phys., Biol.; 11: No. 5, 472-480 (Oct 1972).

Data on hematopoiesis in mice were obtained over a period of 5 to 37 weeks after the intraperitoneal injection of ^{226}Ra. The repopulation ability of bone marrow cells as measured by the ^{59}Fe uptake in the recipient spleens changed in step with the colony forming units. The effects on the latter and the cellularity of the spleen may express the reaction of the irradiated organ to impairment of the blood-forming capacity of the marrow. (auth)

24986 CHROMOSOME DAMAGE AFTER INTRA-ARTICULAR INJECTIONS OF RADIOACTIVE YTTRIUM. EFFECT OF IMMOBILIZATION ON THE BIOLOGICAL DOSE. de La Chapelle, A. (Inst. of Genetics, Helsinki); Oka, M.; Rekonen, A.; Ruotsi, A. Ann. Rheum. Dis.; 31: No. 6, 508-512(Nov 1972).

Chromosome studies were performed on peripheral blood lymphocytes from 25 patients with rheumatoid arthritis after intra-articular injections of radioactive yttrium. Yttrium-90 injections were shown to produce chromosome breakage. There were fewer aberrations in the patients who were immobilized for 3 days after ^{90}Y treatment. The percentage of chromosome rearrangements after ^{90}Y treatment was 2.99 (dicentrics 0.72) in the eleven non-immobilized patients and 1.67 (dicentrics 0.67) in the fourteen who were immobilized. The corresponding figure in a control group consisting of thirteen patients with rheumatoid arthritis who had not received ^{90}Y was 0.47 (dicentrics 0). It was concluded that immobilization is an effective means of reducing biological radiation damage in this type of treatment. When these figures are compared with the corresponding figures for ^{198}Au-treated patients reported by others, the prevalence of chromosome aberrations appears to be much lower with ^{90}Y. This is because far smaller optimum doses are required. (auth)

24987 RADIATION EXPOSURE IN CHILDREN BY NUCLEAR DIAGNOSTIC METHODS. Feine, U. (Univ., Tuebingen, Ger.). Radiol. Clin. Biol.; 41: No. 4, 298-310(1972). (In German).

In the nuclear medical diagnosis, the local radiation exposure in the organ of the child is only in a few cases higher than in x-ray diagnosis. There exist, however, a total-body radiation, exceeding the x-ray radiation of the x-ray procedure, which can lead to unintended, but measurable concentration in organs not examined. The indication should be critically measured considering the pros and cons for the patient to be examined. The development of sensitive apparatus, use of favorable shortlived, non β-emitting nuclides, combined with increased knowledge of distribution and quantitation of radioactive labeled substances, can be expected in order to benefit the large possibilities and advantages of the nuclear medical diagnosis in pediatric medicine. (auth)

24988 CALCULATION OF DOSE RESULTING FROM INHALATION OF RADIOACTIVE AEROSOLS. pp 77-85 of Inhalation Risks from Radioactive Contaminants. Vienna; International Atomic Energy Agency (1973).

See STI/DOC-10/142.

Applications of the ICRP lung model for estimations of the radiation dose to the respiratory tract and other internal organs and tissues following the inhalation of a radioactive aerosol are described. The value of the model for calculations of the maximum permissible intake of various radioactive aerosols for personnel is discussed. (CH)

24989 PATHOLOGICAL EFFECTS FOLLOWING INHALATION OF RADIOACTIVE AEROSOLS. pp 103-107 of Inhalation Risks from Radioactive Contaminants. Vienna; International Atomic Energy Agency (1973).

See STI/DOC-10/142.

Information on pathological changes in man following the inhalation of radioactive aerosols is very limited. Data from several epidemiological studies on uranium miners are reviewed that indicate an increase in the incidence of bronchogenic carcinomas related to cumulative exposure to high levels of radioactivity in mine air. It is pointed out that there are uncertainties in the data in regard to the concentration of ^{222}Rn and its decay products in the mine air, the exposure time, and the number of people at risk. Data from a number of studies on laboratory animals show a relationship between the internal radiation dose and site of deposition of inhaled radioactive aerosols and the incidence of pneumonitis, fibrosis, metaplasia, and neoplasms. It is stressed that species differences preclude the direct extrapolation of animal data to man. (CH)

24990 DOSE CALCULATION FROM BIOASSAY DATA. pp 109-116 of Inhalation Risks from Radioactive Contaminants. Vienna; International Atomic Energy Agency (1973).

See STI/DOC-10/142.

Calculations of internal radiation dose based on the radiometric analysis of biological materials offers advantages over external counting since bioassay does not require the presence of the subject during the measurement. The choice of the material to be counted depends on the radionuclide, the mode of incorporation, and its metabolic behavior, as well as the convenience of the sampling method used. Incorporated radioactive material may be measured in blood, urine, feces, breath, nasal discharge, sputum, sweat, and hair. Of the biological materials assayed, urine is the most commonly used and calculations of the body content of radionuclides from urinary excretion data are relatively easy for radionuclides in the ionic form. In the case of plutonium and other radionuclides that are bound to organic matter the method is less valuable. Formulas are presented for use in estimating the internal dose from urinary excretion data that are applicable to some 30 radionuclides of interest in radiation protection. (CH)

24991 TERMS OF REVEALING TUMORS OF THE SKELETON IN ANIMALS AND HUMANS IN AFFECTIONS CAUSED BY RADIOACTIVE ISOTOPES. Pesternikov, V. M. Med. Radiol.; 18: No. 3, 12-17(Mar 1973). (In Russian).

An analysis of literature data was made of the relation between dose parameters and the terms of revealing osteosarcomas in animals and humans in affections caused by radioisotopes. With reduction of the dose of introduced isotopes, two-fold the terms of revealing osteosarcomas induced by internal irradiation in man and animals under examination increased approximately by 10% from the average life span. (auth)

24992 SOME ASPECTS OF THE HAZARD FROM AIRBORNE THORON AND ITS DAUGHTER PRODUCTS. Duggan, M. J. (National Radiological Protection Board, Sutton, Eng.). Health Phys.; 24: No. 3, 301-310(Mar 1973).

There are no epidemiological studies to provide evidence for an exposure-risk relationship with respect to the inhalation hazard from thoron, (^{220}Rn) and considerations of lung dosimetry are therefore of prime importance. Such considerations, together with those of the relative concentrations of thoron and its daughter products, suggest that the doses from inhaled thoron, (^{212}Bi, and ^{212}Pb), are comparable in some practical situations. Methods of measuring the concentrations in air of these three nuclides are described, and values of the concentrations found in various factories and mines are presented. It was concluded that, although a full assessment of the inhalation hazard from thoron and its daughters requires the measurement of the concentrations in air of all three nuclides (thoron, ThB, and ThC), in many circumstances it is acceptable to assess the hazard from a knowledge of the ThB and ThC concentrations. (auth)

Animals

Refer also to abstract 25043.

24993 (LF-45) FISSION PRODUCT INHALATION PROGRAM. ANNUAL REPORT, OCTOBER 1, 1971-SEPTEMBER 30, 1972. McClellan, R. O.; Rupprecht, F. C. (eds.) (Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.). Nov 1972. Contract AT(29-2)-1013. 363p. Dep. NTIS.

Separate abstracts were prepared on 51 papers in this report. (CH)

For abstracts of individual papers see: 24344, 24487, 24488, 24522, 24849, 24993-25018, 25026, 25027, 25037-25053, 25071, and 25072.

24994 (LF-45, pp 129-136) TOXICITY OF INHALED $^{90}SrCl_2$ IN BEAGLE DOGS. VI. McClellan, R. O.; Benjamin, S. A.; Boecker, B. B.; Hobbs, C. H.; Jones, R. K.; Redman, H. C. Nov 1972.

In fission product inhalation program.

Studies on the metabolism, dosimetry, and effects of inhaled $^{90}SrCl_2$ in the Beagle dog are continuing in an effort to provide a basis for assessing the consequences of inhaling ^{90}Sr such as might be released in certain nuclear accidents. Seventy-two dogs were exposed to aerosols containing ^{90}Sr resulting in initial body burdens ranging from 2.6 to 280 μCi ^{90}Sr/kg. Forty-eight of these dogs are being maintained for lifetime observation. The long-term retained burdens in these dogs range from 1 to 120 μCi ^{90}Sr/kg. Twenty-four dogs with a mean long-term retained burden of 38 μCi ^{90}Sr/kg were assigned to a sacrifice study. Two of these dogs were sacrificed at 5 days, 2 at 1 month, and 2 at 1 year after inhalation of ^{90}Sr. To date, 34 ^{90}Sr dogs have died or been euthanized, 6 during the first 31 days after inhalation of ^{90}Sr with bone marrow aplasia and 28 between 585 days and 2628 days after inhalation of ^{90}Sr. The latter group includes 11 dogs with hemangiosarcomas, 3 with fibrosarcomas, 8 with osteosarcomas, 3 with osteochondrosarcomas, 1 with osteochondrofibrosarcoma, 2 with leukemia, 1 with a baso-squamous carcinoma, 1 with an epileptic seizure, 1 with pneumonia and 1 with cerebellar hemorrhage (4 dogs had both a hemangiosarcoma and an osteosarcoma). The skeletons of the dogs dying with neoplasms received initial radiation dose rates of 4 to 55 rads/day and cumulative doses to death of 3300 to 22,000 rads. Two control dogs have died; one at 2615 days with autoimmune hemolytic anemia and one at 2638 days with a fibrosarcoma. Serial observations are continuing on 32 surviving ^{90}Sr dogs and 20 control dogs. (auth)

24995 (LF-45, pp 137-139) TOXICITY OF INHALED $^{144}CeCl_3$ IN BEAGLE DOGS. VI. Benjamin, S. A.; Boecker, B. B.; Hobbs, C. H.; Jones, R. K.; McClellan, R. O.; Pickrell, J. A.; Redman, H. C. Nov 1972.

In fission product inhalation program.

Studies on the metabolism, dosimetry, and effects of inhaled $^{144}CeCl_3$ in the Beagle dog are continuing in an effort to provide information that will aid in assessing the biological consequences of inhaling ^{144}Ce such as might be released in certain nuclear accidents. Studies on the tissue distribution of inhaled $^{144}CeCl_3$ indicate that ^{144}Ce deposited in the lung is translocated at a moderately rapid rate to liver and skeleton. The pattern of distribution is such that significant radiation doses are accumulated by all three tissues. Fifty-five dogs that inhaled $^{144}CeCl_3$ and 15 control dogs have been placed in a longevity study and will be observed for their lifespan. The ^{144}Ce dogs had initial lung burdens ranging from 20 to 2900 μCi. Twenty-five dogs have died; 8 at 21 to 44 days post-inhalation with signs attributed to severe bone marrow damage and associated pancytopenia; 2 at 138 and 144 days with radiation pneumonitis; 3 at 309 to 874 days with hepatic necrosis; 1 at 510 days with marrow aplasia; 1 at 375 days with pulmonary fibrosis; and 10 at 799 to 2164 days with neoplasms or myeloproliferative disorders. One of the last 10 dogs had an osteosarcoma, 2 had squamous cell carcinomas of the maxilla, 1 of these also having a small papillary adenoma of the lung, 4 had hemangiosarcomas of the liver, 2 had myelogenous leukemia and 1 had myelofibrosis with myeloid metaplasia. Serial observations are continuing on the 30 surviving $^{144}CeCl_3$ dogs and 15 control dogs. (auth)

24996 (LF-45, pp 140-143) TOXICITY OF INHALED $^{91}YCl_3$ IN BEAGLE DOGS. VI. Boecker, B. B.; Benjamin, S. A.; Hobbs, C. H.; Jones, R. K.; McClellan, R. O.; Redman, H. C. Nov 1972.

In fission product inhalation program.

Studies on the metabolism, dosimetry, and effects of $^{91}YCl_3$ in Beagle dogs are continuing with a view to providing information that will aid in assessing the biological consequences of nuclear accidents in which ^{91}Y or other radionuclides that produce a similar radiation dose pattern may be released. Forty-two dogs with ^{91}Y initial lung burdens from 64 to 1300 μCi/kg were placed in four groups with mean lung burdens of 310, 180, 75, and 40 μCi/kg. These dogs and 12 control dogs are being maintained for lifetime observation. An additional four dogs with a mean initial ^{91}Y lung burden of 180 μCi/kg were placed in a sacrifice study. Eleven dogs within the highest exposure groups have died or were euthanized at 17 to 33 days after inhalation of ^{91}Y with changes related to severe bone marrow damage and associated pancytopenia. Two dogs died approximately one year after ^{91}Y inhalation with convulsive seizures that were presumed to be unrelated to the ^{91}Y exposure. One dog was euthanized at 2012 days post-inhalation with a squamous cell carcinoma of the maxilla having recieved an estimated cumulative dose to skeleton of 2900 rads. Thirty-two dogs that had initial lung burdens of 14 to 220 μCi/kg and all 12 control dogs are surviving at 1905 to 2145 days after inhalation of ^{91}Y. Serial observations are continuing on all surviving dogs. (auth)

24997 (LF-45, pp 144-146) TOXICITY OF INJECTED ^{137}CsCl IN THE BEAGLE DOG. V. REDMAN, H. C.; Benjamin S. A.; Hobbs, C. H.; Boecker, B. B.; Jones, R. K.; McClellan, R. O.; Pickrell, J. A. Nov 1972.

In fission product inhalation program.

Studies on the metabolism, dosimetry, and effects of intravenously administered ^{137}CsCl in the Beagle dog are being conducted to aid in assessing the biological consequences of exposure to ^{137}Cs such as might occur in the event of certain nuclear accidents. The effects of the chronic, relatively uniform whole-body exposure produced by ^{137}Cs are being compared with other diverse radiation dose patterns resulting from inhalation of radioactive aerosols. Sixty-six dogs were entered into the study; 6 with a mean initial ^{137}Cs body burden of 3700 μCi/kg, and 12 dogs each with mean initial ^{137}Cs body burdens of 2820, 1940, 1420, 970, and 0 μCi/kg. All six of the highest level dogs died at 19 to 33 days post-injection with cumulative whole-body doses of 950 to 1400 rads. Three dogs in the 2820 μCi/kg level died at 24 to 27 days post-injection with cumulative whole-body doses of 860 to 910 rads. One dog in the 2820 μCi/kg level and one dog in the 1940 μCi/kg level died at 77 and 81 days after injection with cumulative whole-body doses of 1300 to 1400 rads. These early deaths were attributed to severe bone marrow damage, which was reflected in an early dose-related pancytopenia. A dog injected with 1900 μCi ^{137}Cs/kg died acutely at 693 days post-injection with necropsy findings attributed to shock. A control dog died 647 days after being placed on the study with clinicopathological manifestations of an auto-immune hemolytic anemia. Forty-two ^{137}Cs dogs and 11 controls are surviving at 1317 to 1571 days after being placed on experiment. The surviving ^{137}Cs dogs had initial body burdens that ranged from 880 to 3000 μCi/kg and received cumulative whole-body doses of 550 to 2200 rads. Serial observations are continuing on all survivors. (auth)

24998 (LF-45, pp 147-150) TOXICITY OF INHALED ^{90}Y IN FUSED CLAY IN BEAGLE DOGS. IV. Hobbs, C. H.; Chiffelle, T. L.; Hahn, F. F.; Jones, R. K.; Mauderly, J. L.; McClellan, R. O.; Pickrell, J. A. Nov 1972.

In fission product inhalation program.

Studies on the metabolism, dosimetry, and effects of inhaled ^{90}Y in fused clay in the Beagle dog are being continued with a view toward assessing the consequences of inhalation of an energetic beta emitter that has a short effective half-life in the lung. A radiation dose pattern study in which 12 dogs were sacrificed in pairs at 0, 2, 4, 6, 8, and 12 days post-inhalation exposure was completed. A longevity study in which 89 dogs were exposed to ^{90}Y fused clay to date with initial lung burdens ranging from 80 to 5200 μCi/kg and 12 control dogs were exposed to stable yttrium in fused clay is in progress. The ^{90}Y was retained in lung with a half-life that approximated the physical half-life with only small quantities translocated to tracheobronchial lymph nodes, skeleton, and liver. The infinite radiation doses to lung, tracheobronchial lymph nodes, skeleton, and liver, for an initial lung burden of 100 μCi/kg of body weight were estimated to be 1200, 170, 0.54 and 0.38 rads, respectively. Thirty-seven of 39 dogs with doses to lung from 7300 to 55,000 rads have died at 7.5 to 463 days post-exposure and the two surviving dogs in this dose range are showing signs of pulmonary insufficiency at 586 and 550 days post-exposure. All the dogs that have died have shown clinicopathological features, consistent with radiation pneumonitis. Fifty exposed dogs with doses to lung of 990 to 6200 rads are surviving with no significant abnormalities at 548 to 1104 days post-exposure and will be studied for the remainder of the lifespan. (auth)

24999 (LF-45, pp 151-156) TOXICITY OF INHALED ^{91}Y FUSED CLAY IN BEAGLE DOGS. III. Hobbs, C. H.; Cuddihy, R. G.; Hahn, F. F.; Jones, R. K.; Kanapilly, G. M.; Mauderly, J. L.; McClellan, R. O.; Pickrell, J. A. Nov 1972.

In fission product inhalation program.

Studies of the radiological hazards due to inhalation of ^{91}Y in fused clay are being conducted in Beagle dogs to aid in assessing the biological consequences of inhaling a relatively insoluble, high energy β emitter with a short to intermediate effective half-life in the lung. These consist of two parallel efforts: a radiation dose pattern study in which 30 dogs were exposed to ^{91}Y entrapped in fused clay and were serially sacrificed from 0 to 320 days post-exposure; and a longevity study in which 96 dogs have been exposed to ^{91}Y entrapped in fused clay with initial lung burdens ranging from 11 to 360 μCi ^{91}Y/kg of body weight and 12 control dogs exposed to stable yttrium in fused clay. The aerosols ranged in size from 1.5 to 2.6 μm AMAD. Total body deposition of ^{91}Y ranged between 40 and 50% of the inhaled activity with about 22% deposited in the pulmonary region of the lung. The ^{91}Y deposited in the pulmonary region was retained in the lung with a mean effective half life of 50 days whereas the whole-body effective half life was found to be 53 days. Small quantities of ^{91}Y were translocated to the tracheobronchial lymph nodes, liver, and skeleton. Concentrations of ^{91}Y in tracheobronchial lymph nodes exceeded that of the lung by 50 days post-exposure. In the longevity study, 38 dogs have died to date between 113 and 810 days post-exposure. The cumulative radiation dose to lung to death ranged from 6500 to 47,000 rads. Several surviving dogs are presently showing clinical signs typically associated with radiation-induced pulmonary injury. Principal clinical and pathological findings in the dogs that died have been related to pulmonary edema, inflammation, fibrosis, and vasculature obliterative changes. At this time it appears that only dogs with potential infinite radiation doses to lung of less than about 12,000 to 14,000 rads will be long-term survivors. All survivors will be observed over their life-span with particular attention directed toward relating ^{91}Y tissue radiation dose distribution and the resulting clinicopathological effects. (auth)

25000 (LF-45, pp 157-166) TOXICITY OF INHALED ^{144}Ce FUSED CLAY IN BEAGLE DOGS. V. Hahn, F. F.; Boecker, B. B.; Hobbs, C. H.; Jones, R. K.; Mauderly, J. L.; McClellan, R. O.; Pickrell, J. A.; Redman, H. C. Nov 1972.

In fission product inhalation program.

The metabolism, dosimetry, and effects of inhaled ^{144}Ce in fused clay are being investigated in the Beagle dog to aid in assessing the biological consequences of release of ^{144}Ce in a relatively insoluble form such as might occur in certain types of nuclear accidents. Further, the toxicity of inhaled ^{144}Ce fused clay is of broad interest since it may be considered as representative of a group of intermediate-lived beta emitting radionuclides. Two major studies are being performed: a metabolism and dosimetry study in which 24 dogs were serially sacrificed over an extended period of time; and a longevity study with 2 series of dogs; Series 1 with 15 dogs exposed to aerosols of ^{144}Ce in fused clay to yield lung burdens of 11 to 210 μCi/kg and 3 control dogs exposed to nonradioactive clay and Series II with 96 dogs exposed to aerosols of ^{144}Ce in fused clay to yield initial lung burdens of 0.0024 to 66 μCi/kg and 12 control dogs exposed to nonradioactive clay. The ^{144}Ce in fused clay is slowly translocated from the lung to tracheobronchial lymph nodes, liver, and skeleton, however, because of the small size of the tracheobronchial lymph nodes they exceed the lung in ^{144}Ce concentration by 100 days post-inhalation. To date, 23 dogs have died or been euthanized at 143 to 1318 days after inhalation of ^{144}Ce. The prominent findings have been radiation pneumonitis in 17 dogs and in four cases hemangiosarcoma of the lung, in one case both a hemangiosarcoma and a fibrosarcoma and in one case both a bronchiolo-alveolar carcinoma and a hemangiosarcoma of lung. The cumulative radiation dose to the lung to time of death has ranged from 19,000 to 100,000 rads. The 103 surviving dogs include dogs with a potential for accumulating radiation exposures to lung of up to 49,000 rads. Serial observations are continuing on all survivors with special attention directed toward evaluating ^{144}Ce metabolism and dosimetry, and various clinical, pulmonary function, hematologic, serum chemical, and microbiological parameters. (auth)

25001 (LF-45, pp 167-71) TOXICITY OF ^{144}Ce FUSED CLAY INHALED BY IMMATURE BEAGLE DOGS. I. Boecker, B. B.; McClellan, R. O.; Fink, P. G.; Hermes, S. F.; Hobbs, C. H.; Mauderly, J. L. Nov 1972.

In fission product inhalation program.

The metabolism, dosimetry, and effects of ^{144}Ce fused clay inhaled by immature Beagle dogs (about 3 months of age at exposure) is being investigated for comparison with information obtained in companion studies with dogs exposed at 12 to 14 months of age and 8 to 10.5 years of age. These studies will provide as assessment of possible age-related differences in the biological behavior and effects of inhaled radionuclides, differences that may be of significance in predicting the response of accidentally exposed human populations that include individuals of varied age. Eighteen immature dogs have been entered into a radiation dose pattern study to be serially sacrificed at different intervals post-inhalation exposure. Dogs have been sacrificed at 0, 8, 32, and 64 days and tissue analyses indicate a higher content of ^{144}Ce in skeleton than in liver in contrast with the reverse relationship seen in dogs exposed as young adults. The ^{144}Ce content of tracheobronchial lymph nodes was also greater in the immature dogs. Eight dogs exposed to achieve graded initial lung burdens of ^{144}Ce in fused clay and one control dog have been entered as the first block in a longevity study. Additional blocks will be entered into the study in the future. (auth)

25002 (LF-45, pp 172-176) TOXICITY OF ^{144}Ce FUSED CLAY INHALED BY AGED DOGS. I. McClellan, R. O.; Boecker, B. B.; Hahn, F. F.; Hobbs, C. H.; Jones, R. K.; Mauderly, J. L.; Pickrell, J. A. Nov 1972.

In fission product inhalation program.

The toxicity of ^{144}Ce fused clay inhaled by 8 to 10.5 year old dogs is being investigated with a view to providing information on possible age-related differences in the response of older members of the human population to accidental inhalation exposures to radioactive aerosols. The data developed on aged dogs will be compared to the results of similar studies using dogs exposed at approximately 3 months or 12 to 14 months of age. To date, 6 blocks of 5 dogs divided into 4 exposure levels with mean initial lung burdens of 7.7, 14, 24 and 58 μCi/kg body weight and control dogs exposed to non-labeled fused clay have been entered into a longevity study. Three dogs with initial lung burdens of 75, 42, and 28 μCi/kg and cumulative doses to lung of 41,000, 26,000, and 16,000 rads have died at 197, 209, and 214 days post-inhalation of ^{144}Ce with clinico-pathological findings related to radiation pneumonitis and pulmonary fibrosis. The retention and distribution of inhaled ^{144}Ce was similar to that observed in dogs exposed at 18 to 22 months of age in a radiation dose pattern study conducted at this laboratory. Serial observations are continuing on the 27 survivors. (auth)

25003 (LF-45, pp 177-188) TOXICITY OF INHALED ^{90}Sr FUSED CLAY IN BEAGLE DOGS. III. Snipes, M. B.; Barnes, J. E.; Boecker, B. B.; Hahn, F. F.; Hobbs, C. H.; Mauderly, J. L.; McClellan, R. O.; Pickrell, J. A. Nov 1972.

In fission product inhalation program.

Studies on the metabolism, dosimetry, and effects of inhaled ^{90}Sr fused clay in Beagle dogs have been continued with a view toward obtaining information on the biological consequences of inhaling this important radionuclide in a relatively insoluble form. This report emphasizes components of lung retention of ^{90}Sr in fused clay particles as determined using data from a radiation dose pattern study, and recent observations on lung neoplasia observed in dogs in the longevity study. For the radiation dose pattern study, 26 dogs were exposed to aerosols in which activity median aerodynamic diameters ranged from 1.9 to 2.5 μm with a σ_g equal to 1.6 to 2.0. Data from this radiation dose pattern study were used to develop a model for lung loss of the burden. The model included clearance, dissolution, and uptake by tracheobronchial lymph nodes (TBLN). Uptake by TBLN was considered constant at 0.01% lung burden per day (% LB/day). Respective values for clearance and dissolution were 0.3% LB/day and 0.08% LB/day and 0.04% LB/day and 0.05% LB/day for days 10 and 500 post-inhalation, respectively. The ratio for clearance/dissolution was 4.1 and 0.8 for days 10 and 500, respectively, with a ratio of one observed at approximately 400 days post-exposure. A total of 72 dogs were exposed to achieve graded initial lung burdens (ILB) of ^{90}Sr for the longevity study along with 12 dogs exposed to stable strontium in fused clay which are serving as controls. Of the 72 exposed dogs, 32 dogs with ILBs from 29 to 94 μCi/kg and doses to lung to death of 31000 to 75000 rads died from 159 to 414 days post-exposure from radiation pneumonitis and/or pulmonary fibrosis. Three dogs with ILBs of 25, 34 and 36 μCi/kg have died from hemangiosarcomas, one of which was probably primary in soft tissues of an intercostal space or the lung and the other two were most probably primary in the lung. These dogs died at 644, 715, and 718 days post-exposure with cumulative doses to lung of 40000, 47000, and 50000 rads. The remaining 37 dogs and the 12 controls are surviving at 339 to 977 days post-inhalation with no detectable abnormalities. (auth)

25004 (LF-45, pp 189-194) TOXICITY OF INHALED $^{144}CeO_2$ IN MICE. Lundgren, D. L.; Thomas, R. L.; Hahn, F. F.; Sanchez, A.; McClellan, R. O. Nov 1972.

In fission product inhalation program.

One hundred seventy-eight mice, exposed by inhalation to an aerosol of $^{144}CeO_2$ particles, were held for lifespan observations and their survival compared with that of 200 non-treated control mice. Approximately 91% of the initial whole-body burden of ^{144}Ce was cleared within six days. The whole-body burden at six days was estimated to be equivalent to the initial lung burden (ILB) and was retained with a long-term effective retention half-time of approximately 145 days as observed in 35 mice that survived 431 days post-inhalation exposure. The ^{144}Ce retained in the lungs as percent of body burden at death was determined through day 454 post-inhalation exposure. Decreases in the mean survival time and cumulative percent survival were related to the estimated ILBs. The absorbed beta dose to the lung accumulated to the day of death ranged from 10,000 to 32,000 rads. (auth)

25005 (LF-45, pp 199-205) NORMAL RANGES OF SOME CHEMICAL CONSTITUENTS IN THE BLOOD OF BEAGLE DOGS OF VARIOUS AGES. Pickrell, J. A.; Schluter, S. J.; Belasich, J. J.; Stewart, E. V.; Meyer, J.; Hobbs, C. H.; Jones, R. K. Nov 1972.

In fission product inhalation program.

The evaluation of the health status of Beagle dogs prior to and after inhalation of radionuclides has created a need for normal (expected) ranges of blood constituents from dogs of both sexes and at various ages. Expected ranges for 21 blood constituents were developed for Beagle dogs from 2 months to 10 years of age. Cholesterol concentration and gamma globulin percentage increased as a function of increasing age from 1 to 6 years in females, but not in males. Total serum protein concentration also increased as a function of increasing age, in both sexes, for dogs 2 months to 6 years of age. Serum inorganic phosphorus decreased as a function of increasing age in both sexes for dogs 2 months to 6 years of age. Serum alkaline phosphatase was higher in 8- to 10-year-old females and 2- to 3-month dogs than in animals 11 to 14 months of age. An appreciable portion of the population variability was present as within animal variability. (auth)

25006 (LF-45, pp 206-208) SURVIVAL DATA OF LITTERS 1-621 MAINTAINED AT THE FISSION PRODUCT INHALATION LABORATORY. Redman, H. C.; Bielfelt, S. W.; Boecker, B. B.; Hobbs, C. H. Nov 1972.

In fission product inhalation program.

Survival data of Beagle dog litters 1 to 621 from the Fission Product Inhalation Laboratory were analyzed, utilizing the life table method of Cutler and Ederer. The highest percent of death, (18.5%), during any one-month interval occurred from 0 to 1 month of age. The cumulative survival rate at 12 months of age, when dogs for longevity studies are assigned, was 79.4%. This rate dropped to 74.9% by the end of 84 months of age for a decrease in cumulative survival rate of 4.5% during the first 6 years. A comparison of the cumulative survival rate for litters 1-621 has been made with an adjusted cumulative survival rate of control dogs maintained on lifespan studies at the University of California at Davis. (auth)

25007 (LF-45, pp 209-215) TOXICITY OF INHALED ^{144}Ce FUSED CLAY IN BEAGLE DOGS. Pathogenesis Studies. Hahn, F. F.; Benjamin, S. A.; Boecker, B. B.; Hobbs, C. H.; Jones, R. K.; Mauderly, J. L.; McClellan, R. O.; Muggenburg, B. A.; Pickrell, J. A. Nov 1972.

In fission product inhalation program.

A group of 77 beagle dogs have been exposed to ^{144}Ce fused clay and stable cerium fused clay aerosols and are being studied to elucidate the pathogenesis of the lesions induced by inhaled insoluble forms of ^{144}Ce. Three separate but related studies have been initiated: a serial sacrifice study to follow the histology of the induced lesions; a cardiopulmonary function study with sacrifice animals to relate functional and structural changes; and a bronchial cytology study to correlate the cytology findings with pulmonary lesions. The current status of these studies is reported. (auth)

25008 (LF-45, pp 216-221) HEMATOLOGICAL EFFECTS OF INHALED ^{90}Y, ^{91}Y, ^{144}Ce, AND ^{90}Sr FUSED CLAY IN BEAGLE DOGS. Jones, R. K.; Boecker, B. B.; Hobbs, C. H.; Hulbert, A. J.; McClellan, R. O. Nov 1972.

In fission product inhalation program.

An attempt was made to shed light on the etiology of the lymphopenia observed in dogs following inhalation of relatively insoluble forms of beta-emitting radionuclides. The lymphocyte response of dogs that inhaled graded initial lung burdens of either ^{90}Y, ^{91}Y, ^{144}Ce, or ^{90}Sr in fused clay was analyzed over a period of one year post-inhalation exposure. The magnitude of lymphopenia was found to be related to the level of inhaled activity whereas the time at which depression and recovery occurred was found to correlate well with changes in dose rate associated with the four distinctive patterns of radiation exposure to the lung. This suggests that lymphopenia is due to direct radiation damage to circulating lymphocytes as they traverse through the pulmonary vasculature. (auth)

25009 (LF-45, pp 226-229) HEMATOLOGIC CHANGES IN DOGS WITH RADIATION-INDUCED HEMANGIOSARCOMAS. Benjamin, S. A.; Hahn, F. F.; Jones, R. K. Nov 1972.

In fission product inhalation program.

In dogs exposed to aerosols of $^{90}SrCl_2$, $^{144}CeCl_3$, ^{90}Sr fused clay, and ^{144}Ce fused clay, the most common neoplasms found were hemangiosarcomas. These were bone-related in the $^{90}SrCl_2$ study, liver-related in the $^{144}CeCl_3$ study, and mostly lung-related in the ^{90}Sr and ^{144}Ce fused clay studies. Most of these dogs, (20/23) have shown an anemia at least terminally. The genesis of this anemia is discussed. Although there are significant differences between groups with respect to radiation dose and dose pattern to bone marrow, there do not appear to be any differences in the ability of the marrow to respond to hematopoietic stimuli. Microangiopathic hemolytic mechanisms might play a role in causing the anemias but firm evidence for these occurring is lacking. Most of the dogs with anemia had either large or multiple vascular neoplasms or severe hemorrhage or a combination of these. Hemorrhage or sequestration of blood in the tumors could account for most of the anemic changes seen. (auth)

25010 (LF-45, pp 230-233) EFFECT OF AGING ON THE FREQUENCY OF METAPHASE CHROMOSOME ABERRATIONS IN THE LIVER OF THE CHINESE HAMSTER. Brooks, A. L.; Mead, D. K.; Peters, R. F. Nov 1972.

In fission product inhalation program.

One hundred and forty-eight Chinese hamsters, ranging in age from 70 to 1100 days of age, were partially hepatectomized and the frequency of metaphase chromosome aberrations in the liver determined. When the percent of cells with abnormal chromosomes was related to age, there was a linear increase according to the equation $Y = 0.44 + 0.016\ X$; where Y is the percent of cells abnormal, X is age in days, 0.44 is the intercept of the line and 0.016 is the aberration coefficient. These results confirm previously reported data in the literature, which indicate an increase in aberration frequency with time. The aberration frequency does not seem to be inversely related to life span, however, as the slope of our age-response data for hamsters is equal to that observed for long-lived guinea pigs. These data will be useful in long-term radiation studies to establish a baseline for the change in aberration frequency for control animals as they age. (auth)

25011 (LF-45, pp 234-240) EFFECT OF $^{239}PuO_2$ PARTICLE SIZE ON THE FREQUENCY OF CHROMOSOME ABERRATIONS IN THE LIVER CELLS OF THE CHINESE HAMSTER. Brooks, A. L.; McClellan, R. O.; Mead, D. K. Nov 1972.

In fission product inhalation program.

Fifty-four Chinese hamsters received intravenous injections of 10^{-3} μCi ^{239}Pu/gm body weight as monodisperse particles of three sizes: 0.84, 0.44, and 0.12 μm. Eighteen additional animals were injected with saline as controls. The animals were partially hepatectomized in three groups of 24 each at 4, 13, and 40 days to stimulate cell division to permit the recording of metaphase chromosome damage in the liver. Particle size had no effect on the average number of aberrations produced per cell when related to average dose. The aberration frequency increased as a function of dose and time with an aberration coefficient of 1.6×10^{-3} aberrations/cell/rad and an intercept of 0.05 aberrations/cell. This slope was about one-fourth that observed following ^{241}Am citrate injection. When related to local dose, the efficiency of producing aberrations decreased as particle size increased. There was no significant difference in the distribution of aberrations among cells for the different particle sizes. However, at each sampling time, animals injected with the largest particles had cells with the largest number of aberrations. The distribution of aberrations from $^{239}PuO_2$ showed a higher proportion of cells in the normal class and more cells with extreme damage as compared to ^{241}Am citrate. (auth)

25012 (LF-45, pp 241-249) EFFECT OF ^{144}Ce–^{144}Pr AND PARTIAL-HEPATECTOMY ON THE PRODUCTION OF LIVER TUMORS IN THE CHINESE HAMSTER. Brooks, A. L.; Benjamin, S. A.; Jones, R. K.; McClellan, R. O. Nov 1972.

In fission product inhalation program.

Six hundred and fifty (650) Chinese hamsters of similar age and genetic background were introduced into an experiment to determine the combined effect of partial-hepatectomy and intraperitoneal injection of ^{144}Ce–^{144}Pr citrate on the production of liver tumors. These animals were given a variety of treatments with activity levels from 0.036 to 0.25 μCi ^{144}Ce/gm body weight and had either no further treatments or were partially-hepatectomized at either 20 days before or 20 or 200 days after the start of the experiment. Controls were subjected to the same surgical schedule. To date, 50 animals have been sacrificed at 600 days and 92 animals at 700 days post-injection. The dose to the liver at sacrifice has ranged from 1,600 to 15,000 rads and produced from 0.50 to 4.70 chromosome aberrations/cell. The criteria for classification of hyperplastic changes in the liver and hepatocellular neoplasms is discussed in detail. In the animals sacrificed at 600 days, only one hepatocellular neoplasm was found. Animals allowed to live another 100 days developed nine hepatocellular neoplasms and two fibrosarcomas of the liver. Of the hepatocellular neoplasms, six developed in hepatectomized and three in non-hepatectomized hamsters. The number of animals available for study, to date, does not allow conclusions as to the effectiveness of partial hepatectomy as a tumor-inducing treatment. (auth)

25013 (LF-45, pp 255-261) RESPONSE OF SYRIAN HAMSTERS TO PARTIAL BODY ^{60}Co EXTERNAL IRRADIATION. Pickrell, J. A.; Harris, D. V.; Hahn, F. F.; Belasich, J. J.; Jones, R. K. Nov 1972.

In fission product inhalation program.

To study changes in pulmonary collagen biosynthesis resulting from radiation exposure, groups of Syrian hamsters received weekly or bi-weekly fractionated ^{60}Co γ radiation (~500 R per exposure) to the thoracic region to achieve cumulative total doses of 6000, 4000, or 2000 R. In addition, one group received sham exposure. Animals received an injection of ^{14}C proline one day prior to sacrifice at 7 to 8, 13 to 14, 18 to 19, and 21 to 22 weeks after the initial 500 R fraction. Incorporation of ^{14}C proline into the soluble collagen fraction at the 6000 R and 4000 R dose levels was elevated at 7 to 8 weeks after the initial fraction of exposure; but, no increase in pulmonary tissue ^{14}C hydroxyproline or in the ^{14}C-proline incorporation into insoluble collagen was observed. Increased uptake of ^{14}C proline into both soluble and insoluble collagen and an increased pulmonary tissue ^{14}C hydroxyproline concentration was observed at 13 to 14 weeks after the initial fraction of exposure. At 18 to 19 weeks post-exposure, neither an increased ^{14}C proline uptake nor an increased tissue concentration of ^{14}C hydroxyproline was noted. These findings suggest that ^{60}Co external γ irradiation may alter collagen biosynthesis at a relatively early time period by increasing the synthesis of collagen but not pulmonary tissue hydroxyproline concentration. At a later time period, collagen is still being synthesized in increased amounts with increased hydroxyproline tissue concentration and is more heavily cross-linked. At a still later time period, there is no longer an increase in collagen synthesis or an increase in the tissue hydroxyproline concentration. At this later time period, macroscopic and histologic pulmonary lesions were observed in the Syrian hamster. Such findings demonstrate the usefulness and sensitivity of monitoring collagen biosynthesis following pulmonary insult. (auth)

25014 (LF-45, pp 262-267) COMPARISON OF LUNG COMPONENTS FROM VARIOUS SPECIES. Pfleger, R. C.; Henderson, R. F.; Waide, J. J. Nov 1972.

In fission product inhalation program.

A comparison of the neutral lipid and phospholipid composition of pulmonary tissue, surfactant, and exfoliated lining cells from the lungs of four mammalian species (dog, horse, sheep, and hamster) was made. The amount, as well as the composition of lipid present in both lung tissue and surfactant from the four species, was very similar. A species difference was observed in the lipid content of the pulmonary lining cells. The neutral lipid composition of pulmonary tissue showed a consistent pattern between species yet individual variability was evident. Large differences between species were observed in the neutral lipid composition of pulmonary surfactant. In pulmonary tissue, phosphatidyl choline (PC), phosphatidyl ethanolamine, and sphingomyelin were the major phosphatides whereas in pulmonary surfactant, PC and phosphatidyl glycerol accounted for ≥81% of the phospholipid-P from all four species. The surfactant phospholipid composition from all species was similar even though the phospholipid-P profiles from the pulmonary lining cells appeared quite different. The interspecies similarities and differences in the lipid profiles are discussed, (auth)

25015 (LF-45, pp 275-278) EFFECT OF INHALED ^{90}Y IN FUSED CLAY ON PULMONARY CLEARANCE OF STAPHYLOCOCCUS AUREUS IN MICE: STUDY II. Lundgren, D. L.; Hahn, F. F.; Sanchez, A. Nov 1972.

In fission product inhalation program.

Seven hundred and twenty (720) mice were exposed by inhalation to ^{90}Y in fused clay. Two groups with initial lung burdens of 5 to 7 μCi and 8 to 12 μCi ^{90}Y were tested at 1, 2, 3, 4, 7 and 14 weeks post-inhalation exposure to ^{90}Y to determine the pulmonary clearance of inhaled Staphylococcus aureus as compared to sham exposed mice and mice that had inhaled stable yttrium in fused clay. A slight increase in the clearance of inhaled bacteria was evident at 1 week in the mice with ILBs of 8 to 12 μCi followed by a slight suppression at 3 weeks. No other differences in bacterial clearance were observed between the control mice and those that had inhaled ^{90}Y in fused clay. Hematological parameters, histological observations, and weight gain were similar among all groups of mice. (auth)

25016 (LF-45, pp 279-282) PULMONARY FUNCTION MEASUREMENTS IN LABORATORY PONIES. Mauderly, J. L. Nov 1972.

In fission product inhalation program.

Methods currently used for measuring the pulmonary function of Beagle dogs were adopted for use with laboratory ponies. Four series of tests were performed on each of two ponies. Data obtained are compared to results from similar tests performed on Beagle dogs and humans. (auth)

25017 (LF-45, pp 283-286) PERIOD ANALYSIS OF THE DEVELOPMENTAL ELECTROENCEPHALOGRAM OF THE BEAGLE DOG. Redman, H. C.; Hogan, J.; Meuli, M. C. Nov 1972.

In fission product inhalation program.

Electronic analysis of electroencephalographic (EEG) data can be useful in the detection of abnormalities that are not readily detectable on visual analysis. Period analysis of the EEG of the normal Beagle dog from a 3-month puppy to a young adult at

12 months of age was made in order to better interpret the change with age in the frequency of the EEG of the developing Beagle dog. Electroencephalograms of 50 dogs were recorded at 3, 6 and 12 months of age on magnetic tape and analyzed with a period coder. The mean and standard deviation of the percent possible baseline crosses was determined for the above age groups for each EEG band and bipolar lead. The percent of possible baseline crosses for the slowest EEG band showed a decrease with age. There was an increase in activity in the two highest EEG bands through 1 year of age. Other bands showed no consistent change with age. (auth)

25018 (LF-45, pp 305-309) CASTING THE LUNGS IN SITU. Phalen, R. F.; Yeh, H. C.; Raabe, O. G.; Velasquez, D. J. Nov 1972.

In fission product inhalation program.

A method for producing flexible silicone rubber casts of the airways of the lungs in situ is described. Casts are made to correspond to lung volumes occurring during normal breathing. The lung is prepared for casting by replacing the air within with CO_2 followed by filling with degassed physiological saline. The saline dissolves the CO_2 gas within the airways allowing for a bubble-free finished cast. Casting compound is then slowly injected through the trachea. The saline diffuses out of the lung and passes out of the thorax through several small slits in the thoracic wall. After the injection is completed the cast lung is allowed to cure in situ before it is removed and the tissue digested away. Finished casts have an overall shape corresponding closely to the shape of the thorax. Casts produced by this in situ method appear to have more realistic geometrical relationships than those produced from excised lungs. (auth)

25019 LESIONS OF THE BLOOD-BRAIN BARRIER FOLLOWING SELECTIVE INJECTION OF CONTRAST MEDIA INTO THE VERTEBRAL ARTERY IN RABBITS. Comparison Between Lesions of Brain and Spinal Cord. Jeppsson, P. G.; Olin, T. (Lund Univ., Sweden). Acta Radiol., Diagn.; 12: No. 3, 271-282(May 1972).

The toxicity of various modern roentgen contrast media in examinations of the brain and spinal cord was investigated by their selective injection into the vertebral artery of rabbits and evaluated by the damage caused to the blood-brain barrier. The spinal cord was somewhat less vulnerable to contrast media than the brain. (auth)

25020 LATE EFFECTS OF IRRADIATION ON THE THYROID GLAND IN MICE. I. IRRADIATION OF ADULT MICE. Walinder, G. (Foersvarets Forskningsanstalt, Stockholm). Acta Radiol., Ther., Phys., Biol.; 11: No. 5, 433-451(Oct 1972).

The thyroid gland of CBA mice was irradiated by injection of ^{131}I or by local roentgen irradiation, and the effect on the survival and regeneration of the epithelial cells, as well as the frequency of thyroidal neoplasia, were investigated. The irradiation gave rise to initial cell death and to inhibition of the epithelial regeneration. This process led to an increased production of TSH (reflected in increased hypophyseal weight and adenomas of the TSH cell type), and after a time to hyperplastic thyroidal nodules that in some cases developed into neoplasms. (auth)

25021 EXPOSURE TO AIRBORNE RADIOACTIVITY. pp 5-15 of Inhalation Risks from Radioactive Contaminants. Vienna; International Atomic Energy Agency (1973).

See STI/DOC-10/142.

Sources of radioactivity in the atmosphere that result in the inhalation exposure of the human population are reviewed. These include natural radioactivity resulting from the emanation of ^{222}Rn and ^{220}Rn from radium and thorium in the earth's crust or from the interaction of cosmic radiation with atmospheric gases. Man-made sources include fallout radioisotopes from nuclear explosions, radioactive gases released during the operation of nuclear reactors and the possibility of the acute release of airborne radioactivity in the event of a reactor accident, the operation of nuclear fuel reprocessing plants, accidents during the transportation of irradiated nuclear fuels, radioactive waste management practices resulting in the release of radioisotopes to the environment, and some diagnostic medical tests using inhaled radioisotopes as tracers. Possible sources of the occupational exposure of personnel to airborne radioisotopes are discussed briefly. (CH)

25022 CHRONOMUTAGENIC EFFECT OF DEUTERIUM OXIDE ON THE PERIOD AND ENTRAINMENT OF A BIOLOGICAL RHYTHM. Dowse, H. B.; Palmer, J. D. (New York Univ., New York). Biol. Bull.; 143: No. 3, 513-524(Dec 1972).

The effect of deuterium oxide on the locomotor activity rhythm of the house mouse, Mus musculus, was measured in various environmental conditions. In the initial experiments, in which mice were kept in constant low (0.2 foot candle) illumination, D_2O concentrations of 5% through 30% (in 5% increments) were administered via the drinking water. Increased concentrations lengthened the period, proportionally, with 30% D_2O causing a mean period lengthening of 7.4%. Increasing the intensity of illumination in constant conditions lengthens the period of the mouse locomotor activity rhythm. It was felt that deuterium might be changing the way in which the mice interpreted the light intensity, thus changing the period. Both blind mice and mice kept in constant darkness were tested at various dosages. The results did not differ significantly from those obtained for mice in constant low illumination, thus showing D_2O does not act to alter the period by changing the way in which the mice interpret light intensity. Concentrations of D_2O from 5% to 30% in 5% increments were administered to mice in LD 12:12 (8). Doses up through 15% mostly caused phase shifts, at 20% some mice rephased and some were not entrained, while at the higher doses, the rhythms were not entrained to the LD cycle. To test if increasing intensity of illumination in an LD cycle could diminish the perturbing influence of deuterium on the period and phase of rhythms, 20% D_2O was administered to mice in LD 12: 12 (0.2), and LD 12: 12 (80). The rhythms of all the mice in the first category were not entrained by the LD cycle, while all the mice in the second category were entrained. These data clearly indicate that the brighter the illumination during the light interval of an LD cycle, the stronger are its entraining capabilities of D_2O lengthened rhythms. The results are discussed in terms of the bearing they have on clock models, and models for entrainment of rhythms to zeitgeber cycles. (auth)

25023 EXPERIMENTAL ACUTE RENAL FAILURE INDUCED BY URANYL NITRATE IN THE DOG. Flamenbaum, W.; McNeil, J. S.; Kotchen, T. A.; Saladino, A. J. (Walter Reed Army Inst. of Research, Washington, DC). Circulation Res.; 31: 682-698(Nov 1972).

The diminished glomerular filtration rate observed in previous studies of acute renal failure induced by uranyl nitrate was ascribed to backflow of glomerular filtrate through necrotic tubular epithelium, since renal blood flow was essentially normal. Renal blood flow (^{133}xenon washout) and renal function were studied serially for 96 hours after the administration of uranyl nitrate (10 mg/kg, iv) in unanesthetized dogs with chronic renal artery catheters. Inulin clearance and total renal blood flow decreased to 25% and 52% of control, respectively, by 6 hours and remained depressed. By 3 hours, cortical flow decreased to 330 ± 20 ml/min 100 g^{-1} (control 507 ± 12 ml/min 100 g^{-1}) and outer medullary flow increased to 147 ± 8 ml/min 100 g^{-1} (control 97 ± 18 ml/min 100 g^{-1}), indicating intrarenal blood flow redistribution. From 6 hours on, these flow components were no longer separable. The ratio of flow in the outer two-thirds of the renal cortex to that in the whole cortex, determined using ^{85}S-labeled microspheres (15μ), decreased to 0.34 ± 0.06 and 0.40 ± 0.04 at 6 and 96 hours, respectively (control 2.21 ± 0.12). Plasma renin activity was 1.8 ± 0.6 ng/ml $hour^{-1}$ at 3 hours and remained elevated (control 0.6 ± 0.2 ng/ml $hour^{-1}$). Histological examination revealed minimal tubular change at 6 hours and widespread disruption at 96 hours. The decrease in renal blood flow prior to any significant tubular pathology suggests that laterations in renal hemodynamics, which may be mediated by the renin-angiotensin system, are responsible for the diminished renal function observed in this model of acute renal failure. (auth)

25024 BIOLOGICAL ACTION OF LOW-INTENSITY ^{85}Kr β RADIATION ON THE SKIN. Taratukhin, V. R.; Rappoport, I. A.; Lemesh, G. A. Med. Radiol.; 18: No. 3, 50-53(Mar 1973). (In Russian).

When studying the effect of low-intensity ^{85}Kr radiation in a dose of 3 krad no injury to the skin of animals was revealed. Doses from ^{85}Kr in the amount of 4.4 and 7.4 krad brought about the development of radioepidermitis and radiodermatitis with partial or complete restoration of the skin function. ^{85}Kr as compared to ^{133}Xe is a more aggressive radioisotope, which is apparently associated with its greater permeating capacity into the skin. (auth)

Plants

Refer also to abstract 24937.

25025 OBSERVATIONS ON THE EFFICACY OF ^{32}P AS A MUTAGENIC AGENT. Sharma, R. L.; Mukherjee, S. K. (Indian Agricultural Research Inst., New Delhi). Nucleus (Calcutta); 15: No. 1, 45-48(Apr 1972).

^{32}P when fed into young growing grape plants through roots for periods varying up to 22 days did not result in any visible somatic change although there occurred considerable accumulation of ac-

tivity that could be measured in plants after sufficient dilution and disintegration of activity. The berries borne during subsequent years also did not show any change. It was, therefore, concluded that the ^{32}P activity up to 300 μCi when fed for sufficiently long time was insufficient to cause mutation. It is doubtful if higher doses can make it a mutagen comparable to the gamma radiation or some of the chemical mutagens. (auth)

Nuclide Kinetics and Toxicology

Man

25026 (LF-45, pp 29-35) STUDY OF THE IN VITRO SOLUBILITY OF $^{239}PuO_2$. Raabe, O. G.; Boyd, H. A.; Kanapilly, G. M.; Latven, R. K. Nov 1972.

In fission product inhalation program.

The solubility rates of submicrometer particles of $^{239}PuO_2$ under non-equilibrium conditions are being studied using an in vitro system. A continuously flowing stream of serum simulant (at 37°C) passes over and around a sample of particles sealed between membrane filters. Dissolved plutonium is carried off in the stream and measured to determine the rate constant of specific solubility, which for $^{239}PuO_2$ prepared at 1100°C was usually found to be of the order of 10^{-11} gm/cm^2-day. A study of an accidentally produced soluble plutonium aerosol of unknown chemical form or particle size distribution demonstrated the potential usefulness of the in vitro solubility system for rapid range finding of the possible in vivo solubility of aerosol samples collected in accidental releases. (auth)

25027 (LF-45, pp 287-294) BRONCHOPULMONARY LAVAGE AND DTPA TREATMENT OF AN ACCIDENTAL INHALATION ^{239}Pu EXPOSURE CASE. McClellan, R. O.; Boyd, H. A.; Benjamin, S. A.; Cuddihy, R. G.; Hahn, F. F.; Jones, R. K.; Mauderly, J. L.; Mewhinney, J. A.; Muggenburg, B. A.; Pfleger, R. C. Nov 1972.

In fission product inhalation program.

Bronchopulmonary lavage was performed on three occasions on an individual who had accidentally inhaled and deposited in his lung an estimated 450 nCi of ^{239}Pu. The right lung was lavaged on the 8th and 17th day post-exposure and the left lung on the 12th day using large volumes of isotonic saline. Daily treatment with diethylenetriaminepentaacetic acid (DTPA) intravenously was initiated on day 8 post-exposure. Fifty-nine nCi of ^{239}Pu recovered in the lavage fluid was associated predominantly with lung macrophages and relatively little with recovered surfactant. Eighty-seven nCi of ^{239}Pu were excreted in the 11 days following the first lavage; 16 nCi in feces and 71 nCi in urine. In total, 146 nCi of ^{239}Pu and 3.55 nCi of ^{241}Am were recovered during the first 11 days after treatment was initiated. The $^{239}Pu/^{241}Am$ ratio removed via lavage was slightly higher, urine was slightly lower, and feces about the same as the $^{239}Pu/^{241}Am$ ratio of air filter samples obtained at the time of the accident, thus indicating the feasibiltiy of using ^{241}Am lung counting to estimate the ^{239}Pu lung burden at early times following the accident. These data indicate the effectiveness of both bronchopulmonary lavage and DTPA in reducing the body burden of ^{239}Pu following accidental inhalation exposure. (auth)

25028 DECONTAMINATION OF SKIN FROM TRANSURANIUM ELEMENTS. Khodyreva, M. A.; Sit'ko, R. Ya.; Parkhomenko, G. M.; Sarychev, V. A. Gig. Sanit.; No. 12, 57-61(Dec 1972). (In Russian).

A relative accumulation of the isotope was found to take place in the skin layers depending on the type of contamination and the mode of decontamination. On the basis of the investigations performed, the most efficient compounds for the decontamination for skin from ^{241}Am were elaborated and certain measures were suggested for complete prevention or at least for diminishing the extent of skin contamination with radioactive substances. (auth)

25029 INTRAARTERIAL DISTRIBUTION OF COLLOIDAL BISMUTH COMPOUNDS INJECTED IN MAN. Lundell, G. (Karolinska Sjukhuset, Stockholm). Acta Radiol., Ther., Phys., Biol.; 11: No. 5, 395-400(Oct 1972).

The requirements for the use of various compounds of ^{206}Bi for selective radiation therapy by intraarterial injection were examined in eight cases in which the isotope was injected into an iliac artery. An accumulation in the tumor area was obtained with some of the compounds. Redistribution occurred so rapidly, however, that the technique must be considered unsuitable for intraarterial isotope therapy. (auth)

25030 ZASHCHITA I OCHISTKA KOZHNYKH POKROVOV OT RADIOAKTIVNYKH ZAGRYAZNENIY. (Protection and Cleansing of the Skin from Radioactive Contaminants). Tarasenko, N. Yu.; Khodyreva, M. A.; Vorob'ev, A. M. Moscow; Meditsina (1972). 176p.

One of the important aspects of radiation hygiene—protection and cleansing of the skin from contamination by radioactive substances is discussed. The hygienic and radiobiological characteristics of this type of action are considered. Data are included on the qualitative and quantitative parameters of the levels of percutaneous resorption of some radioactive substances in the body, factors that affect the degree of resorption. General and specific methods of protecting and cleansing the skin from radioactive contamination are described. The principles for differential selection of means of decontamination and evaluation of their effectiveness are discussed. The basis for developing cleansing agents, methods of preparing them, and criteria for evaluating them are considered. The book is intended for hygienists, health officers, biologists, physicists, chemists, and industrial workers producing and using radioisotopes. (JPRS)

25031 URANIUM MINING. pp 87-94 of Inhalation Risks from Radioactive Contaminants. Vienna; International Atomic Energy Agency (1973).

See STI/DOC-10/142.

The hazards to uranium mining personnel from inhaled ^{222}Rn and its daughter products produced from radium in the uranium decay series are reviewed. It is pointed out that low levels of Rn have also been found in the air of coal, hematite, and fluorospar mines. The concentration of ^{222}Rn and its daughters in mine air depends on the geological and physical features of the ore and on mining techniques and ventilation. The concentration of activity from ^{222}Rn and daughters is calculated in terms of working level unit (WL). Standards developed by the ICRP and the US Federal Radiation Council for the maximum permissible concentration of activity in mine air are reviewed. Pathways for lung deposition and translocation of inhaled ^{222}Rn and daughters and methods used for estimating the resultant internal radiation dose are discussed. (CH)

25032 FORMALIZED LUNG MODELS. pp 117-122 of Inhalation Risks from Radioactive Contaminants. Vienna; International Atomic Energy Agency (1973).

See STI/DOC-10/142.

Accurate knowledge of the geometry and dimensions of airways of the human lung is needed for the quantitative correlation of structure with respiratory function in relation to the uptake and retention of inhaled radioactive materials. Several formalized lung models developed for studies of inhaled radionuclide kinetics are discussed. A detailed description of Weiber's model is included. (CH)

25033 INTAKE AND EXCRETION OF STABLE CESIUM IN CHILDREN AND TEENAGERS. Pietrzak-Flis, Z.; Bysiek, M. (Central Lab. for Radiological Protection, Warsaw). Nukleonika; 17: No. 10, 555-562(1972).

The content of stable Cs was determined in the diet, urine, and feces of 6- to 7-year-old children from Warsaw, and in the diet and urine of 17- to 19-year-old teenagers from Sochaczew near Warsaw. The samples were collected in the period from January to December 1967. The mean annual content of Cs in the diet of the children and the teenagers was 3.1 ± 0.6 μg/day and 3.2 ± 0.2 μg/day, respectively. The ratio of Cs in the feces to that in the urine of the children was 0.21 ± 0.07. The content of Cs in the bodies of the children, as estimated from the excretion, was 0.14 ± 0.02 mg. The content of Cs in the bodies of the teenagers, as estimated from the intake, was 0.53 ± 0.17 mg. The Observed Ratio OR = (^{137}Cs/Cs in urine/^{137}Cs/Cs in diet) was close to unity (1.04 ± 0.08 for the children and 1.05 ± 0.19 for the teenagers), what would seem to indicate a lack of fractionation of these two isotopes of Cs in the human body. (auth)

25034 MEASURE OF THE EFFECTIVENESS OF DTPA CHELATION THERAPY IN CASES OF PLUTONIUM INHALATION AND PLUTONIUM WOUNDS. Schofield, G. B.; Lynn, J. C. (British Nuclear Fuels Ltd., Sellafield). Health Phys.; 24: No. 3, 317-327 (Mar 1973).

DTPA (Diethylene Triamine Penta Acetic Acid) was administered i.v. to six subjects, involved in accidents that resulted in plutonium exposures. Four instances of plutonium inhalation are described. In three instances the contaminant was either plutonium oxide or plutonium/uranium oxide; in the fourth instance the contaminant was plutonium nitrate in the form of an aerosol spray. Only in this latter case was the DTPA chelation therapy demonstrated to have been effective. Two cases of plutonium contaminated wounds are considered. In the instance when the contaminant was in the form of a metal splinter of plutonium the DTPA chelation therapy was effective. An estimated total of 5190 pCi of plutonium was eliminated in the urine during the first 40 days post incident, and 29% of the amount taken into the system was removed by the application of chelation therapy, assuming that the amount remaining is excreted according to a Langham power function equation. (auth)

25035 ALKALINE EARTH METABOLISM IN ADULT MAN. A Report Prepared by a Task Group of Committee 2 of the Inter-

national Commission on Radiological Protection. Marshall, J. H.; Lloyd, E. L ; Rundo, J.; (and others) (Argonne National Lab., IL). Health Phys.; 24: No. 2, 125-221(Feb 1973).

A new whole-body retention function is presented. The human data considered in developing the model range from 15 min to 50 yrs after injection and include bone, calcium, strontium, barium, and radium. The results are presented in four ways; summary graphs of the whole-body and internal retention functions for each alkaline earth from 10^{-2} to 10^{5} days after intraveneous injection; twenty-six graphs that compare the model with the data available; tables of the eight retention functions for each alkaline earth from 15 min to 87 yrs after injection; and tables of integrals of the retention functions for each alkaline earth isotope (including radioactive decay) to 1 yr and to 50 yrs after injection. The model is intended to be useful both as a tool for further metabolic research and for calculating radiation doses to special groups of cells in human bone. Estimates are given of the accuracy of the new model, and the new model is compared with existing models. (UK)

25036 PARTICLE SIZE DISTRIBUTION OF RADIUM-CONTAINING PHOSPHOR POWDERS. McAllister, R. G. (Liberty Mutual Research Center, Hopkinton, MA); Reist, P. C.; Evans, R. D.; Wallhausen, C. W. Health Phys., 24: No. 4, 430-433(Apr 1973).

A study was made of the size of radium particles in self-luminous paints used for dial painting during World War II, and the results are presented. It was concluded that one possible personnel exposure route was that of ingestion, whereby relatively large particles trapped in the nasopharyngeal and upper bronchial areas were swallowed. This method of uptake should always be considered when dealing with highly toxic materials. (CH)

Animals

Refer also to abstracts 24522, 24937, 24993–25004, 25007–25009, 25011, 25012, and 25015.

25037 (LF-45, pp 37-49) INTERPRETATION OF RESULTS FROM STUDIES WITH MONODISPERSE FUSED CLAY AEROSOL PARTICLES. Thomas, R. G.; Thomas, R. L.; Boecker, B. B.; Kanapilly, G. M.; McClellan, R. O. Nov 1972.

In fission product inhalation program.

Several studies were conducted with monodisperse, ^{137}Cs-labeled, fused clay aerosol particles, using both in vivo and in vitro systems. Dogs were exposed by inhalation to monodisperse ($\sigma_g \sim 1.1$) particles having aerodynamic diameters of ~0.4, 1.7, and 3.0 μm. Syrian hamsters inhaled aerosols with aerodynamic diameters of ~0.6, 0.7, 0.8, 1.5, and 2.6 μm plus a polydisperse aerosol with aerodynamic median size of 1.9 μm and $\sigma_g = 1.5$. In vivo solubility characteristics of some of these same particle sizes were determined following intramuscular injection of particle suspensions into Syrian hamsters. In vitro solubility studies were also performed on similar aerosol particle suspensions. These data are interpreted in several ways including the following: initial pulmonary deposition versus particle size; absorption from the lung to internal organs as a function of particle size; interlobar patterns of initially deposited particles; in vitro solubility characteristics compared to in vivo results; interpretation of in vivo solubility results in terms of lung clearance mechanisms; gross whole-body and organ retention patterns as related to particle diameter; comparison of initial deposition patterns of monodisperse and polydisperse particles following inhalation. Future plans with monodisperse particles are discussed in light of the relationships established. (auth)

25038 (LF-45, pp 50-54) EXPOSURE OF SYRIAN HAMSTERS TO ^{51}Cr LABELED AEROSOLS OF $^{239}PuO_2$. Mewhinney, J. A.; Hobbs, C. H. Nov 1972.

In fission product inhalation program.

Syrian hamsters were exposed to a ^{51}Cr labeled $^{239}PuO_2$ aerosol to determine the effectiveness of the gamma emitting tag as an aid in the determination of lung burden of $^{239}PuO_2$ during and soon after experimental exposures. Aerosol sampling during this exposure indicated a bimodal particle size distribution with about 25% of the ^{51}Cr activity associated with particles less than 0.5 μm AMAD and of unknown density. The remaining ^{51}Cr and all ^{239}Pu activity was associated with particles of 2.0 μm AMAD and density of 10.3 gm/cm^3. Whole-body retention, initial tissue deposition, and lung retention of the labeled aerosol was consistent with the bimodal particle size distribution. In vitro solubility studies on the reclaimed aerosol particles used in the exposure confirmed the aerosol characterization and animal data regarding the nature of the aerosol. Results of this study indicated that a modification of the techniques and aerosol preparation methods was necessary to insure complete incorporation of ^{51}Cr into the $^{239}PuO_2$ aerosol particles. (auth)

25039 (LF-45, pp 55-60) IN VIVO SOLUBILITY OF INTRAMUSCULARLY INJECTED ^{51}Cr–^{239}Pu OXIDE PARTICLES. Thomas, R. G. Nov 1972.

In fission product inhalation program.

A $^{239}PuO_2$ aerosol was labeled with ^{51}Cr for use for in vivo measurements of initial deposition and early retention following inhalation exposure. A collection foil from a Lovelace Aerosol Particle Separator run was used as the source material for three suspensions of monodisperse ^{51}Cr-labeled particles of $^{239}PuO_2$ which were administered by intramuscular injection into the hind leg of Syrian hamsters and rats. Two animals from each species and three dummies were injected at each particle size (median diameters of ~1.0, 0.4, and 0.1 μm). A suspension was also made from the back-up filter from an inhalation run with a medium diameter of ~0.5 μm, and a portion of this was injected as with the other suspensions. Animals and dummies were periodically whole-body counted for ^{51}Cr; all animals were sacrificed on day 41. Tissue analyses were done for ^{51}Cr and for ^{239}Pu. The ratio of radionuclides in the injection site was compared to that in the dummies and although it varied between particle size groups it was consistent within groups. The results indicate that ^{51}Cr is a good label for $^{239}PuO_2$, as long as certain precautions are taken in administration of the aerosol to the animal. (auth)

25040 (LF-45, pp 61-64) EARLY DISTRIBUTION AND RETENTION OF 0.3 μM MONODISPERSE $^{239}PuO_2$ PARTICLES IN THE CHINESE HAMSTER. Retherford, J. C.; Brooks, A. L.; McClellan, R. O. Nov 1972.

In fission product inhalation program.

Forty-eight Chinese hamsters were intravenously injected with monodisperse 0.3 μm $^{239}PuO_2$ particles labeled with ^{51}Cr. Twenty-four animals were injected at each activity level of 2×10^{-3} and 6×10^{-5} μCi ^{239}Pu/gm body weight. Four animals at each activity level were sacrificed at 0, 2, 4, 8, 16, and 32 days post-injection. The ^{239}Pu was avidly retained with a slight decrease by 32 days to 94% of the initial activity. At all sacrifice times, the liver, spleen, and remaining carcass contained about 90%, 2.0% and 8.0% respectively, of the sacrifice body burden. The activity per gram of tissue was about equal for the liver and spleen, indicating equal competence of the reticuloendothelial system in these two organs and an equal dose commitment. These studies will serve as a basis for average and local dose calculations in future pathological and cytogenetic studies using monodispersed $^{239}PuO_2$ particles. (auth)

25041 (LF-45, pp 65-68) MULTISPECIES STUDY OF THE METABOLISM OF ^{252}Cf. Mewhinney, J. A.; Harris III, M. D. Nov 1972.

In fission product inhalation program.

The retention and organ distribution of ^{252}Cf citrate administered by intraperitoneal injection were compared in Beagle dogs, Syrian hamsters, Chinese hamsters, rats, and mice for 128 days post-injection. The percent initial body burden retained varied among the species studied whereas the computed effective half-life of retention (400 to 600 days) was not species-dependent. Principle organs of deposition for all species were skeleton and liver with small quantities of ^{252}Cf found in nearly all tissues and organs. Skeletal retention was avid in all species whereas hepatic retention varied among species. The Beagle dog and two hamster species retained 80% or more of the 8-day hepatic burden through the 128-day study period. The rat and mouse eliminated their hepatic burden rather rapidly with only 20% of the 8-day burden present at 128 days post-injection. Excretion patterns varied among species with the Beagle dog and two hamster species showing predominantly urinary excretion whereas for the rat and mouse, fecal excretion predominated. Hepatic elimination and predominance of fecal excretion in the rat and mouse were thought to be related to an ability in these two species to mobilize hepatic burdens and excrete ^{252}Cf via the bile into the intestine. (auth)

25042 (LF-45, pp 69-73) NASAL ABSORPTION OF CsCl, $SrCl_2$, $BaCl_2$, AND $CeCl_3$ IN SYRIAN HAMSTERS. Cuddihy, R. G.; Ozog, J. A. Nov 1972.

In fission product inhalation program.

Absorption of $^{137}CsCl$, $^{85}SrCl_2$, $^{133}BaCl_2$ and $^{144}CeCl_3$ from the nasopharynx directly into the general circulation was studied in Syrian hamsters and compared with gastrointestinal tract absorption. More than 50% of the ^{137}Cs, ^{85}Sr, and ^{133}Ba but less than 4% of the ^{144}Ce was absorbed directly from the nasopharynx. For all isotopes, nasal absorption was approximately equal to or greater than gastrointestinal absorption during the first 4 hr after administration. This study emphasized the importance of direct nasal absorption of deposited materials in inhalation toxicity evaluations especially with readily soluble aerosols having mass

median aerodynamic diameters greater than 5 μm when nasopharyngeal deposition predominates. (auth)

25043 (LF-45, pp 74-76) RETENTION AND TISSUE DISTRIBUTION OF ^{144}Ce FOLLOWING INHALATION OF $^{144}CeO_2$ IN SYRIAN HAMSTERS. Thomas, R. L.; McClellan, R. O. Nov 1972.

In fission product inhalation program.

Retention and distribution of inhaled $^{144}CeO_2$ was studied in Syrian hamsters for more than one year and comparisons made with similar data obtained in other species. A 110-day effective half-time of whole-body retention was established after about 200 days. Lung remained the primary organ of interest, having 88% of the sacrifice body burden at 320 days after inhalation exposure. Liver contained about 8% and skeleton 3% of the body burden at that time. Measurable quantities of ^{144}Ce were detected in tracheobronchial lymph nodes, ranking the lymph nodes second to lung in radiocerium concentration at the later sacrifice times. At 320 days, concentration ratios of lung-to-lymph nodes-to-liver were approximately 70:2:1. The infinite β-radiation dose to lungs of animals in this study was calculated to be about 4200 rads per μCi ^{144}Ce initial lung burden. (auth)

25044 (LF-45, pp 77-84) RETENTION CHARACTERISTICS OF INHALED, RELATIVELY INSOLUBLE FORMS OF ^{144}Ce IN MICE. Thomas, R. L.; Lundgren, D. L.; McClellan, R. O.; Bennick, J. E. Nov 1972.

In fission product inhalation program.

Two studies are reported, the first having provided impetus for the second. Mice were exposed to an aerosol of ^{144}Ce entrapped in fused montmorillonite clay particles. About 95% of the deposited material was cleared within one week post-inhalation exposure. Lung was the organ of highest ^{144}Ce concentration throughout the study and retained ^{144}Ce with an effective half-time of 85 days. Build-up of ^{144}Ce in skeleton and liver was also noted, such that at 256 days post-inhalation exposure the skeleton contained 48% and liver 11% of the body burden, compared to 33% in lung. These data differed from those of other studies in mice with $^{144}CeO_2$ and ^{144}Ce-fused clay, where inhaled material was held more tenaciously in the lung, incomplete fusion of the aerosol particles was assumed responsible for the differences noted and was the basis for a second study in which groups of mice were exposed to ^{144}Ce clay aerosols produced under various conditions of temperature and air flow. Preliminary whole-body retention data from the latter study are included and the importance of aerosol characterization in the routine monitoring of potential exposure areas is discussed. (auth)

25045 (LF-45, pp 85-89) METABOLISM OF INHALED ^{124}Sb IN THE SYRIAN HAMSTER AS A FUNCTION OF VALENCE STATE. Felicetti, S. W.; Thomas, R. G.; McClellan, R. O. Nov 1972.

In fission product inhalation program.

Several radionuclides, such as radioantimony, that are present in a reactor inventory have potential for being present in accidentally produced aerosols in more than one valence state. To evaluate the importance of this variable, the metabolism of inhaled trivalent and pentavalent ^{124}Sb tartrate was studied in Syrian hamsters and found to vary with valence state. Whole-body clearance of both the trivalent and pentavalent forms exhibited two phases. The first was rapid clearance of a large proportion of the initial body burden; the second was a longer term retention with a biological half-life of 16 days. Much of the activity was recovered in feces, but some urinary excretion was also observed. The trivalent antimony concentrated in the red blood cells (RBCs) with peak RBC/plasma ratios occurring in the day one samples. The pentavalent antimony was found mainly in the plasma in the day zero samples, but was concentrated in the RBCs in subsequent samples. In the tissues, substantial accumulation was noted in liver, skeleton, and pelt. The liver accumulated trivalent antimony to a greater extent than pentavalent antimony. However, after inhalation of the pentavalent ^{124}Sb aerosol, skeleton always contained a greater concentration of the activity than did the liver, and therefore would be more important in dose considerations. The pelt, and especially hair, accounted for a large proportion of the body burden. (auth)

25046 (LF-45, pp 90-95) EFFECT OF TEMPERATURE OF AEROSOL FORMATION ON METABOLISM OF INHALED ^{124}Sb IN THE BEAGLE DOG. Felicetti, S. W.; Thomas, R. G.; McClellan, R. O. Nov 1972.

In fission product inhalation program.

To evaluate the influence of varied thermal treatment on the biological behavior of radioantimony aerosols, groups of three dogs were exposed to aerosols that had been nebulized from a ^{124}Sb-tartrate complex and passed through a heating column maintained at 100, 500, or 1000°C. One dog from each group was sacrificed at 32, 64, and 128 days post-exposure. Increasing the temperature appeared to decrease the mean particle size of the aerosol. The aerosol with largest particle size, generated at 100°C, showed the least overall whole-body retention, due primarily to rapid early clearance. Much of this aerosol was cleared from the upper respiratory tract or was solubilized in the lung and excreted in the urine. The 500°C aerosol was retained to a greater extent than the 1000°C aerosol, both in the lungs and on a whole-body basis. Average long-term biological half-lives were 100, 36, and 45 days for the 100, 500, and 1000°C aerosols, respectively. Elimination occurred in both urine and feces, with urine/feces ratios for individual collections generally less than one. Red blood cells were observed to concentrate ^{124}Sb. In the tissues, ^{124}Sb concentrations were highest in the lung, thyroid, liver, spleen, and pelt. For all three aerosols, the thyroid concentrated ^{124}Sb to a greater extent than any other tissue. With the 500 and 1000°C aerosols, the lungs contained the next highest concentrations of ^{124}Sb. The pelt contained ^{124}Sb concentrations second only to the thyroid for the aerosol at 100°C. Because of its size, the pelt contained a large portion of the body burden at all sacrifice dates for all three aerosols. Skeletal concentrations of ^{124}Sb were significant only for the 100°C aerosol. (auth)

25047 (LF-45, pp 96-102) IN VITRO SERUM PROTEIN BINDING OF SOME CITRATED LANTHANON NUCLIDES AND THE BEHAVIOR OF ^{144}Ce(III) AND ^{91}Y(III) AS CITRATED AND SERUM PROTEIN BOUND FORMS IN BEAGLE DOGS AFTER INJECTION. Kanapilly, G. M.; Chimenti, R. A. Nov 1972.

In fission product inhalation program.

In vivo serum protein binding of ^{144}Ce and ^{91}Y was determined after intravenous injections of the citrate and serum protein bound forms of ^{91}Y and ^{144}Ce in Beagle dogs. In all cases the percent of ^{91}Y and ^{144}Ce bound to protein was similar to that observed in vitro. Tissue distribution and excretion patterns of injected ^{144}Ce and ^{91}Y in citrate and protein bound forms were studied in eight dogs by whole-body counting. No major difference in the behavior of the same nuclide injected as citrate or protein form could be observed. A possible explanation for these observations may be the rapid formation of equilibrium conditions in the blood after injection of either chemical form. The differences in serum protein binding capacities may be a possible explanation for the general trend in distribution and excretion patterns of lanthanons injected as citrate. (CH)

25048 (LF-45, pp 103-106) TREATMENT OF SCANNING DATA FOR DETERMINATION OF IN VIVO SOLUBILITY CHARACTERISTICS. Thomas, R. G. Nov 1972.

In fission product inhalation program.

Inhaled particles that are deposited in the lower respiratory tract are partly cleared by dissolution. This process is dynamic, in that an ion released from a particle surface normally acts independently of the particle, and behaves according to its chemistry. The ion may bind to materials in the lung or enter the blood. In studies of inhalation toxicology, the solubility characteristics of inhaled aerosols are of interest. One technique used to obtain these data is that of measuring the retention pattern of aerosol particles following intramuscular injection of a suspension of the particles. A brief description is given of an approach used in analyzing small animal (hamster and rat) scanning data following intramuscular injection of various forms of ^{133}Ba, to determine values that describe its solubility characteristics. (auth)

25049 (LF-45, pp 107-118) CORRECTION OF RECTILINEAR SCANNER DATA TO DETERMINE THE LUNG BURDEN OF $^{90}Sr-^{90}Y$ FUSED CLAY PARTICLES IN THE BEAGLE DOG. Snipes, M. B. Nov 1972.

In fission product inhalation program.

A rectilinear scanner is used routinely to determine the lung burden in Beagle dogs exposed to aerosols containing relatively insoluble radioactive particles such as $^{90}Sr-^{90}Y$ in fused montmorillonite clay. Determination of the lung burden of $^{90}Sr-^{90}Y$ in fused clay particles has the associated problem of a background level of ^{90}Sr resulting from dissolution of a portion of the lung burden and deposition in skeleton. Acceptable estimates for lung burden of $^{90}Sr-^{90}Y$ in fused clay particles are possible using the following procedure: determine the net radioactivity content per channel for the 184 channels (extra-lung) comprising the scan regions anterior and posterior to the 61 channels defined as the lung peak region of the scan; subtract 1.43 times the net radioactivity content per channel in the extra-lung region of the scan from each channel of the lung peak portion of the scan; and sum the net corrected lung peak channels to yield the value for lung burden of $^{90}Sr-^{90}Y$ in fused clay. (auth)

25050 (LF-45, pp 195-198) COMPARISON OF THE PULMONARY FUNCTION OF IMMATURE, YOUNG ADULT, AND AGED BEAGLE DOGS. Mauderly, J. L. Nov 1972.

In fission product inhalation program.

Pulmonary function measurements were performed on immature, young adult, and aged Beagle dogs. The results of those measurements are compared and apparently age-related differences are noted. (auth)

25051 (LF-45, pp 268-274) MEASUREMENT OF THE QUANTITY OF SURFACTANT REMOVED BY SERIAL LAVAGE IN BEAGLE DOGS AND COMPARISON WITH TOTAL LUNG SURFACTANT. Henderson, R. F.; Pfleger, R. C. Nov 1972.

In fission product inhalation program.

The quantity of surface active material removed in serial lavages of Beagle dogs was measured and compared with the amount of surface active material remaining in the lavaged lung. The amounts of surfactant removed by each lavage at weekly and biweekly intervals were approximately equal and equivalent to that calculated to be required to cover the alveolar surface area with a monomolecular layer. The amount of surfactant removed by lavage was a small portion (15 to 20%) of the total surface active material of the lungs, and consistent with the observed rapid replacement of lavageable surfactant. The data indicate that the amount of surfactant removed by pulmonary lavage is not sufficient to be deleterious to the animal. (auth)

25052 (LF-45, pp 295-303) REMOVAL OF INHALED ^{144}Ce FUSED CLAY FROM THE BEAGLE DOG LUNG BY BRONCHOPULMONARY LAVAGE. Muggenburg, B. A.; Boecker, B. B.; McClellan, R. O.; Clarkson, S. P.; Mares, F. J.; Benjamin, S. A. Nov 1972.

In fission product inhalation program.

The effectiveness of bronchopulmonary lavage for removing ^{144}Ce in fused clay from the lungs was investigated in Beagle dogs. Twelve Beagle dogs were exposed to a ^{144}Ce in fused clay aerosol and eight of these dogs received 10 saline lavage treatments, five on each lung. Four dogs received no lavage treatment. The initial lung burden was reduced by 54% in six of the treated dogs and 22 and 26% in two dogs. This reduction in initial lung burden over a 56-day treatment period resulted in a reduction in the radiation dose to lung to 90 days by 44% and the potential cumulative dose by 48%. An additional group of four dogs was exposed to an aerosol of fused clay only and were given 10 lung lavages over a 56-day period. No significant clinical changes due to treatment were observed in these animals. All of the dogs in this study survived 90 days and are now under observation in the colony. (auth)

25053 (LF-45, pp 310-314) USE OF A HEAT TRANSFER ANALOGY FOR THE MATHEMATICAL MODEL OF RESPIRATORY TRACT DEPOSITION. Yeh, H. C. Nov 1972.

In fission product inhalation program.

Mathematical models, predicting the aerosol deposition in the respiratory tract, are reviewed. Data in the literature indicated not only that the air flow in the trachea and major bronchi may not be laminar, but also that the entrance effect of the tube or airway has not been considered. A new approach to a mathematical model of respiratory tract deposition, based on the analogy of the heat and mass transfer, is discussed. (auth)

25054 (RLO-2231-1) STUDIES ON THE CONCENTRATIONS OF ^{55}Fe IN SOUTH PACIFIC OCEAN WATER AND MARINE ORGANISMS AND IN THE COLUMBIA RIVER. Progress Report, March 1, 1972-November 30, 1972. Jennings, C. D. (Oregon Coll. of Education, Monmouth (USA)). 1972. Contract AT (45-1)-2231. 13p. Dep. NTIS $3.00.

Data are presented on the content of ^{55}Fe and ^{65}Zn in the common squaw fish (Ptychochulas oregonense) and the common carp (Cyprinus carpio) collected in the Columbia River during 1972. The content of stable iron was measured in marine organisms (Euphaused, anchovy, herring, and shrimp) collected from various locations of the Pacific Ocean. (CH)

25055 RETENTION AND DISTRIBUTION OF METHYLRADIOMERCURY IN PIGS. Bergman, T.; Ekman, L.; Oestlund, K. (Royal Veterinary Coll., Stockholm). Zentralbl. Veterinaermed., Reihe A; 19: No. 9, 753-765(Oct 1972).

A study was made on pigs concerning the retention and distribution of methylradiomercury given orally, together with three different doses of stable methyl mercury. The doses of MeHg correspond to 0.02, 1.0, and 5.0 mg Hg per kg body weight. The pigs were killed 36 days after the administration. The whole-body retention of ^{203}Hg, as studied by whole-body measurement, could be described by a single exponential function. The biological half-life after correction for incorporation of mercury into hair was 21 days at all dose levels used. Based on blood data, the corresponding half-lives were, for the lowest dose level 22.2 days, and for the highest level 19.9 days, the difference not being statistically significant. The concentration of ^{203}Hg in blood was highest in the pigs given the highest dose of stable methyl mercury. The ratio between the concentration in blood cells and in blood plasma was constant at the two dose levels investigated and during the whole experimental period. The distribution study performed at the end of the experiment showed that the hair contained the highest concentration of ^{203}Hg. Fairly high concentrations were found in the liver, kidneys, and certain muscular tissues, and in the lens of the eye. In several tissues investigated, the highest concentration was obtained when the highest dose of stable methyl mercury was given. This was also the case for the nervous tissue and there was a general tendency for the highest radiomercury concentration to be found in the most differentiated nervous tissues. Considerable variations in the concentration between different skeletal muscle groups were noted, which is of importance from the food hygiene point of view. (auth)

25056 KINETICS OF PENETRATION OF RADIOACTIVE CONTAMINATION INTO THE SKIN. Vasilev, G.; Mikhailov, M.; Sharov, P. Rentgenol. Radiol.; 10: No. 2, 98-104(1971). (In Bulgarian).

The penetration and distribution of radioactive contamination into the skin was studied in young swine using ^{131}I in an aqueous solution of NaI. Within 30 min, 10 to 15% of the activity entered the deep layers of the skin and could not be removed. Within 60 min 30 to 40% of the activity entered the deep layers. The downward distribution in the epidermis was exponential in nature. (ERB)

25057 PHARMACOLOGIC PROPERTIES OF A NEW ORAL CONTRAST MEDIUM FOR CHOLECYSTOGRAPHY. Rosati, G.; De Micheli, P.; Schiantarelli, P. (Bracco Industria Chimica SPA, Milan). Acta Radiol., Diagn.; 12: No. 3, 355-356(May 1972).

A new contrast medium, coded B 8890, proved to be remarkably bilitropic in the rat, rabbit, cat, and dog. It has a lower level of acute toxicity, better intestinal absorption, and a more consistent enterobiliary recirculation that ipanoic acid and ipodate. Moreover, B 8890 has little affinity for the plasma albumins. (auth)

25058 HEALING OF SPLIT SKIN AUTOGRAFTS AFTER STORAGE IN DEUTERATED MEDIUM. An Experimental Study. Wandall, J. H. (Univ., Copenhagen). Scand. J. Plast. Reconstr. Surg.; 6: No. 1, 36-39(1972).

By using split skin autografts, tissue survival in deuterized medium was studied. Split skin grafts were stored for 48, 72, and 96 hrs at different temperatures. Survival was evaluated on the basis of the take and of the histological appearance after reimplantation. Survival of deuterated grafts was not increased as compared with grafts stored in conventional medium. (auth)

25059 TRANSLOCATION. pp 59-67 of Inhalation Risks from Radioactive Contaminants. Vienna; International Atomic Energy Agency (1973).

See STI/DOC-10/142.

Mechanisms involved in the lung clearance of inhaled radioactive aerosols in mammals and pathways for translocation of radionuclides to the gastrointestinal tract, tracheobronchial lymph nodes, or into the systemic circulation and thence to bones, liver, kidneys, or excretion in urine or feces are reviewed. The influence of the chemical form of the radioactive compound and its solubility, the nature of the radionuclides, and aerosol particle size on lung retention and translocation are discussed. Results from studies of the tissue distribution of inhaled natural uranium dusts, and aerosols of $^{238}PuO_2$ and $^{239}PuO_2$ in dogs and rats are presented. It is pointed out that data from the experimental studies did not quite agree with data derived using the ICRP lung model. (CH)

25060 ICRP LUNG MODEL (1971). pp 69-75 of Inhalation Risks from Radioactive Contaminants. Vienna; International Atomic Energy Agency (1973).

See STI/DOC-10/142.

The characteristics of the ICRP lung model for deposition and retention of inhaled radioactive materials are reviewed. Constants to be used with the model are described. Calculations of $^{238}PuO_2$. clearance half time using the model agreed well with experimental data on dogs. (CH)

25061 TISSUE DISTRIBUTION OF RADICIODINATED HUMAN GROWTH HORMONE IN THE MOUSE. Mizejewski, G. J. (Veteran's Administration Hospital, Ann Arbor, MI). Proc. Soc. Exp. Biol. Med.; 142: No. 2, 589-594(Feb 1973).

The distribution of human growth hormone (HGH) labeled with ^{125}I was studied in mature and immature intact mice. The ^{125}I-HGH appeared to be biochemically homogeneous and possessed both biologic and immunologic activity. Uptake of ^{125}I-HGH in mice occurred initially in the liver, but the highest radioconcentration values occurred in the seminal vesicle (SV) of the male mice at 3.0 hr postinjection. Other tissues and organs in the male mice did not take up the radiolabeled HGH. Radio-uptake in a sexually equivalent organ of the female could not be demonstrated. ^{125}I-HGH levels were higher in the SV of immature than in mature male mice; however, this difference was not significant. The use of

anti-HGH antiserum employed as a blocking agent specifically inhibited the uptake of ^{125}I-HGH in the SV of the mouse. Growth hormone was discussed as a biologic synergist in an attempt to explain the localization of ^{125}I-HGH in the SV. Uptake of the radiohormone in the liver may have resulted from either (a) a blood clearing mechanism, or (b) stimulation of hepatic protein anabolism. It was suggested that continual stimulation of the sex accessory glands could result in hyperplasia and, conceivably, anaplasia. (auth)

25062 MAMMARY TRANSFER OF ^{203}Hg FROM MOTHERS TO BRAINS OF NURSING RATS. Yang, M. G.; Wang, J. H. C.; Garcia, J. D.; Post, E.; Lei, K. Y. (Michigan State Univ., East Lansing). Proc. Soc. Exp. Biol. Med.; 142: No. 2, 723-726(Feb 1973).

At the 16th day of lactation, rats were force-fed a tracer dose of ^{203}Hg as $CH_3{}^{203}HgCl$ and allowed to continue to nurse their pups. After 1, 2, 3, and 5 days of nursing, representative pups were killed and brains obtained. The mother was also killed at the end of the study and its brain and those from the pups were separated into brain parts and radioactivities determined. In the mother, the concentrations of ^{203}Hg ranged from 0.117 in the medulla to 0.167 in the hypothalamus and 0.205% of dose/g tissue in the pituitary. In the pups, the quantity of labeled mercury deposited in the brain or brain parts increased from 1 day to 5 days of suckling. The concentration (% of dose/g of brain or brain part) also increased with succeeding day of nursing so that at the end of 5 days the pup brain contained a higher concentration than their mothers' brain (0.307 vs 0.131). Correspondingly, pup brain parts contained greater concentrations of labeled mercury than their mothers' brain parts: Cerebrum, 0.287 vs 0.122; cerebellum, 0.353 vs 0.164; pons plus midbrain, 0.319 vs 0.146; medulla, 0.330 vs 0.117; and hypothalamus, 0.392 vs 0.167. (auth)

25063 KINETICS OF ISOTOPIC EQUILIBRATION OF IODINE IN INDIVIDUAL RAT THYROID FOLLICLES. Loewenstein, J. E.; Wollman, S. H. (National Cancer Inst., Bethesda, MD). Endocrinology; 92: No. 3, 894-911(Mar 1973).

Estimates of the relative concentration of radioiodine in individual follicles at various stages of isotopic equilibration were made by microdensitometry of autoradiographs. Data at 1 hr after a single injection of radioiodide were used to obtain clearances of blood radioiodide by single follicles. For central follicles clearances appeared proportional to the surface area of the lumen. The observed size independence of the concentration at isotopic equilibrium indicated that clearance of luminal iodoprotein was proportional to the surface area of the lumen also. These results indicated that average uptake and release of radioiodine per cell are independent of follicle size. The analysis of the size distribution of radioiodine concentration in follicles at 4 days indicated that the fraction of iodine released per day varied inversely with the lumen diameter. Clearance of colloid was approximately 115 μ^3 per cell per day. Results were similar for peripheral follicles except that clearances and exit rate constants were about half those for central follicles. In addition to the size-dependent equilibrating component there was also a slowly equilibrating size-independent component in the gland possibly amounting to as much as 30% of thyroid iodine. This component appeared to be present in all follicles but formed a larger fraction of the iodine in peripheral follicles than in central follicles. Estimates also indicate that slow diffusion of iodoprotein in the lumen of the follicle does not significantly retard the equilibration of the whole gland. The results indicate that the kinetics of equilibration and the release of iodine from the whole gland are likely to be complex. (auth)

25064 EFFECT OF ESTROGEN ON THE PHOSPHOLIPID METABOLISM OF RAT BONE. Cruess, R. L.; Hong, K. C.; Iida, K. (Royal Victoria Hospital, Montreal). Endocrinology; 92: No. 3, 961-963(Mar 1973).

The influence of estrogen on phospholipid synthesis of bone was investigated using both in vitro and in vivo systems. Rats were injected with 17β-estradiol benzoate im and ^{32}P orthophosphate sc. The metaphyseal and diaphyseal portions of the bone were separated, and the total phospholipid content and the incorporation of ^{32}P orthophosphate into the phosphatides of bone were determined. When estrogen was administered to ovariectomized rats, the phospholipid content of diaphyseal bone increased. The incorporation of ^{32}P into phospholipid was increased in the metaphyseal and diaphyseal bones of estrogen treated animals. The effect of estrogen on the incorporation of ^{32}P into phosphatides was observed primarily in phosphatidyl choline and sphingomyelin. These results suggest that estrogen enhances the synthesis of some phospholipids of bone and that this may be related to the inhibition of resorption which is known to occur. (auth)

25065 BEHAVIOR OF ^{237}Np IN THE RAT. Morin, M.; Nenot, J. C.; Lafuma, J. (CEN, Fontenay-aux-Roses, France). Health Phys.; 24: No. 3, 311-315(Mar 1973).

Rats were administered ^{237}Np nitrate either intravenously or intramuscularly. Similar distributions in organs were observed after intravenous injections at pH 1.5 and 7.5. Intramuscular injections were followed by a high urinary excretion, about 30% of the total administered dose, over the 1st month, while over 60% migrated from the injection site. The ratio of "activity eliminated via urine/activity deposited in bone" was roughly equal to 1. DTPA therapy was not effective. Neptunium behavior followed that of alkaline earths rather than that of transplutonium elements. (auth)

25066 COMPARATIVE METABOLISM OF RADIONUCLIDES IN MAMMALS. 8. Retention of Beryllium in the Mouse, Rat, Monkey, and Dog. Furchner, J. E.; Richmond, C. R.; London, J. E. (Los Alamos Scientific Lab., NM). Health Phys.; 24: No. 3, 293-300(Mar 1973).

The distribution and retention of ^{7}Be in mice, rats, monkeys, and dogs were determined in 4π liquid scintillation counters after oral, intraperitoneal, and intravenous injection. Less than 1% was absorbed from the gut after oral dosage. About 50% was excreted within $\frac{1}{4}$ day after parenteral dosage. Bone was the principal site of deposition of absorbed ^{7}Be, but the lower large intestine was the organ receiving the greatest amount of radiation from ingestion of the radionuclide. (auth)

25067 AVAILABILITY TO AQUATIC ANIMALS OF SHORT-LIVED RADIONUCLIDES FROM A PLOWSHARE CRATERING EVENT. Harrison, F. L. (Univ. of California, Livermore). Health Phys.; 24: No. 3, 331-343(Mar 1973).

The accumulation of the debris radionuclides ^{95}Zr/^{95}Nb, ^{103}Ru, ^{110m}Ag, ^{124}Sb, ^{131}I, ^{140}Ba/^{140}La, ^{141}Ce, ^{185}W, and ^{198}Au was studied in freshwater animals (goldfish, crayfish, and clams) and marine animals (gobies, crabs, mussels, and clams) representative of the types of aquatic animals used for food by man. The radionuclides were made available by continuously recirculating aquarium water through a column containing fallout material from the nuclear cratering event Cabriolet. Circulation was started 2 days before the animals were added and continued for the 3 to 4 weeks of the experiment. All the radionuclides were detected in either or both freshwater and seawater, but the relative concentrations in the water differed from those in the debris due to differences in leachability. The radionuclides of antimony, iodine, barium, and tungsten were quite leachable, those of ruthernium, silver, and gold less leachable, and those of zirconium and cerium not very leachable. All except ^{95}Zr/^{95}Nb were detected in some or all of the animals analyzed. Most of the radionuclides were found in highest concentrations in the fractions of the body that contained the visceral organs. The concentration factors (animal/water) were higher in the bivalve mollusks and crustaceans than in the fishes and were generally lower than those previously reported. This is attributed to absence of steady-state conditions and differences in chemical and physical form of the radionuclides. The main potential contributors to the whole-body dose to man from these freshwater and marine animals are ^{131}I, ^{140}Ba/^{140}La, and ^{185}W. (auth)

25068 DISTRIBUTION OF RADIOCESIUM IN ANIMALS. Zotov, V. G. Veterinariya; 48: No. 5, 85-86(1971). (In Russian).

The hexachlorotellurite method was used to analyze ^{137}Cs in 139 bovine organ samples (5217 animals) and in 184 sheep. The highest levels of ^{137}Cs were found in muscles. Animals grazing in the Kyzylkums had levels 8 times higher than animals fattening on cottonseed. Levels were different in individual muscles. Cesium-137 levels in testicles of fattening bulls and rams did not differ significantly from those in muscles. However, the levels were lower in bulls and rams grazing in the Kyzylkums. This is attributed to different elimination half-times for different organs and to differences in the ^{137}Cs content in food. Cesium-137 levels were higher in accessory tissues of the testicles than in the testicles of rams, and were consistently lower in ovaries than in testicles. The brain contained the same levels as muscles in sheep, but in cows the level in the brain was only the same as in ovaries. Levels in udders depended on the lactation period; they were the same as in ovaries in cows and lower in sheep. The blood contained only 20% of the amount found in muscles. Tissues are classified according to the distribution coefficient. (ERB)

25069 WHOLESOMENESS OF IRRADIATED SHRIMPS. van Logten, M. J. (National Inst. of Public Health, Bilthoven, Netherlands); den Tonkelaar, E. M.; van Esch, G. J. Food Cosmet. Toxicol.; 10: No. 6, 781-788(Dec 1972).

Seven groups each of ten male and ten female rats received for 90 days either a standard diet or diets containing nonirradiated, 150-krad γ-irradiated, or 300-krad γ-irradiated shrimps at a level

of 2.8 or 28% of diet on a dry weight basis. No effects on growth, food intake, composition of blood, serum glutamic-pyruvic transaminase, organ weights or histopathology were attributable to the consumption of irradiated shrimp, but administration of a diet containing 28% shrimps, either irradiated or nonirradiated, affected the relative weights of the liver, kidneys, and ovaries. In the liver, fatty vacuolation occurred to an extent that increased with the dietary level of shrimps, but again the effect was no more marked with the irradiated than with the nonirradiated diets. (auth)

Plants

25070 RADIOACTIVELY CONTAMINATED LICHENS AND THEIR SPECIAL RADIOHYGIENIC SIGNIFICANCE. Kiel, R.; Randow, F.; Schulze, H. A.; Fleischer, I. (Univ., Rostock, Ger.). Z. Gesam. Hyg. Ihre Grenzgeb.; 16: No. 12, 898-902(1970). (In German).

On the basis of literature data the contamination of plants of the polar zone, especially of lichens, by fallout radionuclides and their inclusion in the terminal nutritional chain of man (Laplanders and Eskimoes) is discussed. As has been revealed by some studies on some lichen species on different sites in the region of the Baltic Sea coast, there was a ^{90}Sr contamination ranging from 0.01 to 0.03 nCi/g ash or 1.1 to 2.4 nCi/kg (dry weight) and ^{137}Cs contents ranging from 0.08 to 0.91 nCi/g ash or 8.1 to 38.1 nCi/kg. These results are compared with findings from Lapland and Alaska. (auth)

New Tracer Techniques

Refer also to abstracts 24508, 24620, and 25038–25040.

25071 (LF-45, pp 119-128) TISSUE BLOOD VOLUMES AND WEIGHTS IN ADULT BEAGLE DOGS. Cuddihy, R. G.; Hall, R. P.; Hobbs, C. H.; Boecker, B. B.; Muggenburg, B. A. Nov 1972.

In fission product inhalation program.

Tissue blood volumes and weights were measured in adult Beagle dogs to provide basic information relevant to tissue dosimetry in this species of experimental animal. Dogs were administered ^{51}Cr- or ^{59}Fe-labeled red blood cells or ^{131}I-labeled human serum albumin and sacrificed by exsanguination via cardiac puncture while under pentobarbital anesthesia or by inducing circulatory arrest with intravenous injection of KCl, both with and without prior anesthesia. Surgically implanted blood vessel occluders were used to isolate certain lung lobes from the general circulation immediately prior to sacrifice in order to assess terminal changes in the pulmonary blood distribution. Beagle dogs used in this study weighed about 10 kg and had an average blood volume in 1000 ml. Lungs, liver, spleen and kidneys were determined to be composed of about 50% blood by weight and hence would be most affected by the mode of sacrifice. Sodium pentobarbital anesthesia exerted a marked effect upon blood cell pools in the spleen. Exsanguination removed blood rather uniformly from all tissues in proportion to the total amount withdrawn with the exception of the skeleton. (auth)

25072 (LF-45, pp 250-254) UPTAKE OF RADIOACTIVE LABELED PROLINE IN SYRIAN HAMSTERS. Pickrell, J. A.; Harris, D. V.; Hahn, F. F.; Jones, R. K. Nov 1972.

In fission product inhalation program.

The uptake of radioactive labeled proline was assessed as a means of evaluating collagen biosynthesis in lung tissue. Radioactive proline was injected intraperitoneally into Syrian hamsters, which were sacrificed at various times post-injection. Radioactive uptake into pulmonary tissue, the radioactive hydroxyproline content of this tissue, and radioactive uptake into various connective tissue fractions were determined. Carbon-14 whole-body retention and $^{14}CO_2$ exhalation were also determined in some animals. No appreciable incorporation was observed in the crude acid mucopolysaccharide or the insoluble elastin fractions. Both soluble and insoluble collagen fractions had appreciable amounts of radioactivity incorporated into them. Little difference in proline incorporation into either soluble or insoluble collagen was noted between day 1 and day 2 post-injection; however, by day 7, appreciable decreases in the radioactivity of the soluble collagen uptake were noted. Radioactive proline incorporation into pulmonary tissue paralleled to a degree the incorporation into the soluble and insoluble collagen fraction. A gradual fall observed in radioactive proline concentration in pulmonary tissue to day 3, suggests that proline was incorporated into proteins with relatively short biological half-lives. Very little radioactive hydroxyproline was present in pulmonary hamster tissue. These data lend confidence to the use of this procedure to monitor collagen biosynthesis and to more adequately describe the pathogenesis of pulmonary fibrosis. (auth)

25073 BRAIN SCANNING WITH A NUCLEAR ENTERPRISES SCINTICAMERA IV. Pexman, J. H. W. (Midland Centre for Neurosurgery and Neurology, Smethwick, Eng.). Bio-Med. Eng.; 8: No. 1, 16-19(Jan 1973).

Brain tumors and disturbances of the blood supply to the brain can often be detected using a rectilinear scanner after injecting the patient with a radiopharmaceutical; now gamma cameras are being used for the same investigation. A study is described that was carried out to compare the performance of a conventional scanner (Picker V Magnascanner) and the Nuclear Enterprises Scinticamera IV gamma camera. The results indicate that the resolution of the Scinticamera IV is not quite as good as the scanner, but it has the advantage of speed and can also be used for dynamic studies. (UK)

25074 PROPERTIES AND PURIFICATION OF N-ACETYL-MURAMYL-L ALANINE AMIDASE FROM STAPHYLOCOCCUS AUREUS H. Singer, H. J.; Wise, E. M. Jr.; Park, J. T. (Tufts Medical School, Boston). J. Bacteriol.; 112: No. 2, 932-939 (Nov 1972).

The principal autolytic enzyme activity of the cell sap of Staphylococcus aureus H was purified 400-fold. It is an N-acetylmuramyl-L-alanine amidase. This enzyme has a molecular weight of 8 to 10×10^3, a pH optimum of 7.3, an ionic strength optimum of 0.16 M, and a K_m of 10^{-3} M murein repeating units. A new radioactive assay method is described. (auth)

25075 PERIPHERAL LEVELS OF ESTROGEN IN THE CYCLIC HAMSTER. Baranczuk, R.; Greenwald, G. S. (Univ. of Kansas, Kansas City). Endocrinology; 92: No. 3, 805-812(Mar 1973).

Peripheral levels of plasma estrone (E_1) and estradiol (E_2), as measured by RIA, showed little correspondence in the cycling hamster. A diurnal pattern of E_1 was apparent during the cycle with peak levels reached at 2200. Estradiol levels were low on the first 2 days of the cycle, correlated with the absence of antral follicles, but were higher at 2200 of day 2. A peak was reached at 1400 of day 3 (approximately 90 pg/ml) and the levels remained elevated for at least 8 hr. E_2 was depressed at 0900 of day 4, but this was followed by an almost linear increase between 0900 and 1500 when the highest value for the estrous cycle was attained (186.6 pg/ml). A sharp decrease, down to baseline values, followed. The day 4 peak in E_2 was temporally related to the preovulatory surge in LH and an abrupt increase in ovarian progesterone. Phenobarbital (Phen) injected to day 4 cycling animals prevented the E_2 peak at 1500, whereas the addition of 5 μg of LH restored E_2 to normal values. However, E_1 was not affected by either Phen or LH. Injection of Phen to day 3 animals at 1300 lowered E_1 and E_2 levels, but this treatment does not affect the time of ovulation. LH administration on day 3 elevated E_1 and E_2 to levels comparable to day 4 cycling animals. Unilaterally ovariectomized animals displayed depressed E_1 levels as compared to controls only on day 3 of the first cycle while E_2 was significantly elevated on day 1 and lowered on day 3. By the second cycle E_1 and E_2 did not differ from intact control animals. Chronic hypophysectomy (for 8 days) yielded E_1 values comparable to ovariectomized hamsters, but E_2 values were significantly higher. LH administration did not increase either E_1 or E_2, indicating that antral follicles are necessary for optimal estrogen secretion. Plasma estrogen levels in the hamster were much higher than values previously reported for the rat, guinea pig and rabbit, and within the range found in man and rhesus. This seems to represent a true species difference since assays on rat and rabbit plasma, using the same RIA technique used with the hamster, yielded E_1 and E_2 values similar to those reported in the literature. (auth)

25076 DOUBLE-ISOTOPE METHOD FOR COMPARING POLYRIBOSOME POPULATIONS: EFFECTS OF GLUCOCORTICOID HORMONE ADMINISTRATION. Loeb, J. N. (Columbia Univ., New York). Endocrinology; 92: No. 3, 857-861(Mar 1973).

A simple double-isotope technique is described, which permits a detailed comparison of polyribosomes isolated from co-homogenates of livers from control and glucocorticoid-treated animals. By means of this method it is shown that glucocorticoid hormone administration to adrenalectomized rats results in a true reduction in the number of ribosomal monomers and dimers in liver and in a consistent increase in the proportion of large polyribosomes. By specifically excluding the possibility that the hormone-induced changes in polysome size distribution can be ascribed to artifacts appearing during the course of isolation, the results of this study provide an explanation for the well-known enhancement of in vitro amino acid incorporating activity of liver polyribosome preparations from glucocorticoid-treated animals. It is suggested that this sensitive method for comparing polyribosome populations may find use in other systems as well. (auth)

25077 NEW RADIOISOTOPIC MICROASSAY OF CELL-MEDIATED IMMUNITY UTILIZING ^{99m}Tc LABELED TARGET CELLS. Gillespie, G. Y.; Barth, R. F.; Gobuty, A. (Univ. of Kansas, Kansas City). Proc. Soc. Exp. Biol. Med.; 142: No. 2, 378-382(Feb 1973).

The ^{99m}Tc microcytotoxicity assay is a simple and sensitive means of assessing cell-mediated immunity in vitro. The short labeling time and high binding affinity of the nuclide are significant advantages over other radioisotopic assays. The short half-life is adequately compensated for by the high labeling efficiency and specific activity of the isotope. (auth)

25078 USE OF ^{14}C-CYANATE FOR RED BLOOD CELL SURVIVAL STUDIES. Landaw, S. A. (Univ. of California, Berkeley). Proc. Soc. Exp. Biol. Med.; 142: No. 2, 712-715(Feb 1973).

When incubated with rat RBC in vitro, or following direct intravenous injection, ^{14}C-cyanate is firmly bound to RBC of all ages. Red blood cell lifespan can be determined by following circulating RBC hemoglobin specific activity, yielding a value of 56 to 58 days for the mean lifespan, in agreement with that obtained from cohort studies. Similarly, mean potential lifespan (time to senescent death) and rate of random hemolysis were similar to that noted after cohort labeling. It was concluded that ^{14}C-cyanate is an excellent noneluting random label for RBC survival studies. (auth)

25079 HANDLING OF RADIOISOTOPES. Hightower, D. (Texas A and M Univ., College Station). J. Amer. Vet. Med. Ass.; 161: No. 11, 1549-1551(Dec 1972).

The types of licenses and procedures for obtaining licenses for the use of radioisotopes as tracers in the USA are reviewed. Methods for the radiation protection of personnel using radioisotopes as tracers are outlined. (CH)

25080 POSSIBLE CAUSES OF THE RAISED BACKGROUND ON TRITIUM AUTORADIOGRAMS AT PROLONGED EXPOSITIONS. Merkulov, M. F.; Leskova, S. G.; Kortukov, E. V.; Korogodina, G. Ya. (Inst. of Experimental and Clinical Oncology, Moscow). Tsitologiya; 15: No. 1, 111-114(Jan 1973). (In Russian).

A diffuse rise of the background was noted during an autoradiographic study of biological objects with a high tritium, which cannot be accounted for by the effect of the isotope β-radiation. It is suggested that the appearance of the background may involve a decelerating irradiation or the luminiscence of the autoradiographic system, induced by the tritium radiation. The role of the latter deserves a particular consideration in exposing tritium autoradiograms at low temperatures. (auth)

25081 APPLICATION OF IONIZING RADIATION AND TRACER TECHNIQUE IN VETERINARY SCIENCE. Pethes, G. Izotoptechnika; 15: No. 11, 561-566(Nov 1972). (In Hungarian).

The applications of radioisotopes in studies on metabolism, biology of feeding, endocrinology, biology of reproduction, and immunology in veterinary sciences are discussed. (auth)

25082 STUDIES OF PORTAL CIRCULATION AFTER INTRASPLENIC INJECTION OF RADIO-NUCLIDES USING A SCINTILLATION CAMERA. Kuba, J.; Seidlova, V. (Palacky-Univ., Olomouc, Czech.). Radiobiol.-Radiother.; 14: No. 1, 45-52 (1973).

A new technique is described for the appraisal of the portal system by percutaneous intrasplenic application of ^{99m}Tc pertechnetate and ^{131}I MAA. The flow of a radioactive bolus via the portal routes was recorded by using a scintillation camera: On the basis of sequential images displayed on the screen of the persistence scope and from the radioactivity curves over the v. lienalis, the liver and the precordium which were obtained by using a video tape recorder and multichannel analyzer, not only the presence of portosystemic shunts but also their type and the site of the obstruction in the portal system could be detected. (auth)

MATERIALS

Ceramics and Cermets

Refer also to abstracts 24344, 24347, 24487, 24492, 24495, 24515, 24521, 24805, 25129, 25185, 25253, 25320, 25408, 26631, and 26849.

25083 (AD-867181) RESEARCH ON DIFFUSION IN MULTIPHASE TERNARY SYSTEMS; REACTION DIFFUSION IN THE Ti/SiC AND Ti–6Al–4V/SiC SYSTEMS. Technical Report, 1 May–31 December 1969. Ratliff, J. L.; Powell, G. W. (Ohio State Univ. Research Foundation, Columbus). Mar 1970. 91p. (AFML-TR-70-42). NTIS.

A detailed description and analysis of the experimental results obtained from the investigation of reaction diffusion in the Ti/SiC and the Ti–6Al–4V/SiC systems are presented. In addition, an analysis of the problem of reaction diffusion in a metal–nonmetal (Ti–C) system with a single intermediate phase is presented. (NTIS)

25084 (AD-877904) DEVELOPMENT OF OXIDATION-RESISTANT, HIGH-STRENGTH, NIOBIUM-BASE ALLOYS. Final Technical Report, 1 July 1966–30 June 1969. Roche, T. K.; Graham, D. L. (Union Carbide Corp., Kokomo, Ind. Stellite Div.). Jan 1970. Contract AF33(615)-3856. 197p. (AFML-TR-69-344). NTIS.

A program was carried out for the development of a fabricable niobium-base alloy with improved oxidation resistance and good strength-properties at 2000°F and above for use as a blade material in gas turbine engines. Nineteen electron-beam-melted ternary alloys from the Nb-W-Ta and Nb-W-Hf systems within the composition range 10 to 25% tungsten, 15 to 30% tantalum, 2 to 35% hafnium, were evaluated for fabricability, tensile and creep-rupture strength properties, and oxidation resistance. (NTIS)

25085 (CEA-N-1588) OUT-OF-PILE STUDIES OF REACTIONS BETWEEN U AND Pu OXIDES AND Na. Housseau, M.; Dean, G.; Marcon, J. P.; Marin, J. F. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). Jan 1973. 51p. (In French). Dep. NTIS (U. S. Sales Only) $4.50.

Out-of-pile reactions between Na and mixed U and Pu oxides were studied using radiography to measure the variations in the oxide volume. The effects of the Pu content, the departure from stoichiometry of the oxide, the reaction temperature and time, and the presence of fission products were studied. The effect of the oxygen content of the Na was established, and the reaction products were identified and their natures specified. The O/M ratio above which the oxides cease to be compatible with Na was determined as a function of the Pu concentration. The reaction limits are proposed for U–Pu and O compositions corresponding to a Pu valency greater than about 3.4. It was found that the amplitude of the reaction between 600 and 900°C is proportional to the difference between the initial and equilibrium O/M ratio, temperature-independent, and proportional to the burnup in the case of oxides containing fission products. The temperature modifies the reaction kinetics but does not alter the threshold or the amplitude. It is concluded that mixed oxides are only compatible with Na under stoichiometric oxide conditions or very strict Na purity conditions; but the environmental conditions for the fuel element may modify the effect of these reactions on its behavior. (France)

25086 (HEDL-TME-73-19) ENTHALPY AND HEAT CAPACITY OF $U_{.75}Pu_{.25}O_{2-x}$ (25 TO 1490°C). Gibby, R. L. (Hanford Engineering Development Lab., Richland, Wash.). Jan 1973. Contract AT(45-1)-2170. 36p. Dep. NTIS $4.00.

The enthalpy of $U_{.75}Pu_{.25}O_{2-x}$ was measured from room temperature to 1490°C for oxygen to metal ratios of 1.98 and 1.95. Measurements were made using a drop calorimeter system employing a Bunsen ice calorimeter. The data obtained can be represented by the following relationships for each O/M. O/M = 1.98; $H°(T) - H°(298°K) = -6748 + 18.41T + 1.504 \times 10^{-3} T^2 + 3.361 \times 10^5/T$. $Cp(T) = 18.41 + 3.007 \times 10^{-3} T - 3.361 \times 10^5/T^2$. O/M = 1.95; $H°(T) - H°(298°K) = -7288 + 19.65T + .7595 \times 10^{-3} T^2 + 4.067 \times 10^5/T$. $Cp(T) = 19.65 + 1.519 \times 10^{-3} T - 4.067 \times 10^5/T^2$; H°(T) – H°(298°K) is in cal/mole, Cp(T) is in cal/mole °K, and T is in °K. (auth)

25087 (JAERI-M-4749) NONDESTRUCTIVE INSPECTION OF THE COATED FUEL PARTICLES BY CONTACT X-RAY MICRORADIOGRAPHY. Kashimura, S.; Hayashi, T.; Iwamoto, K. (Japan Atomic Energy Research Inst., Tokyo). Mar 1972. 16p. (In Japanese). NTIS (U. S. Sales Only).

An x-ray microradiographic technique was investigated for nondestructive inspection of the coated fuel particles, using a low-energy x-ray beam and several kinds of x-ray films placed in contact with the particles. Radiographic images with high contrast and resolution could be obtained by proper selection of the x-ray energy, exposure time, kind of film, and geometric factors. It was found to be applicable to nondestructive measurement of the sizes of kernel and coating layers and observation of the particle shape and a kernel movement, and even for the neutron-irradiated particles. A neutron-radiographic technique for the particles and the fuel compact was also investigated; it was found to be unsuitable for this purpose. (auth)

25088 (JAERI-M-4814) THERMO-ELASTIC EXPANSION OF FINITE CYLINDERS. Harayama, Y.; Izumi, F.; Fujita, M. (Japan Atomic Energy Research Inst., Tokyo). May 1972. 28p. (In Japanese). NTIS (U. S. Sales Only).

In fuel pellets, the height compared with the diameter is small, so that the end effects are appreciable. These effects contribute significantly to a kind of cladding deformation known as circumferential ridging. In order to evaluate the end effects, a program was prepared to obtain the thermal expansion of finite cylinders (fuel pellets), based on J. Veeder's procedure (AECL-2660). It is assumed in programming that thermoelastic equations are applicable throughout the volume of the cylinder, and that no external forces are operative at the cylinder surfaces. The coding method, inputing and outputing for the program (called the DEFORM) are described. (auth)

25089 (JAERI-M-5008) ANALYTICAL STUDIES ON THE MECHANICAL BEHAVIOR OF TRISO-2 COATED FUEL PARTICLES DURING IRRADIATION. Arai, T.; Sato, S. (Japan Atomic Energy Research Inst., Tokyo). Oct 1972. 52p. (In Japanese). NTIS (U. S. Sales Only).

In design study for the Experimental Multi-Purpose High-Temperature Reactor, the mechanical behavior and integrity of TRISO-2 coated fuel particles during irradiation were studied analytically. Information is included on stress analysis, evaluation of fuel-particle mechanical integrity, and criteria for future studies. Results of analyses using the computer code MICROS for TRISO-2 coated fuel particles, show that stress variations for the respective layers of a TRISO-2 particle can be revealed, and three different modes of coating failure can be distinguished. The effects of initial PyC quality, irradiation temperature, particle size, fission gas release, and creep on coating stresses are clarified. The physical properties are also clarified, especially in relation to the mode of coating failure. Evaluation of the difference between reactor and experimental irradiation conditions is discussed along with mechanical failures occurring in irradiation tests, and validity of the data available on the mechanical strengths of coating materials. (auth)

25090 (KFK-1706) SINTERING OF URANIUM MONONITRIDE PELLETS. Siebmanns, W. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Material und Festkoerperforschung). Oct 1972. 96p. (In German). Dep. NTIS (U. S. Sales Only) $7.00.

Thesis. Submitted to Karlsruhe Univ. (West Germany).

High-purity inert gas atmospheres are not needed in the fabrication of UN powders for pellet sintering if oxidation of the powders is minimized by coating a suitable protective layer such as stearic acid. Powders ground to a suitably fine particle size with an average around 1 μm or less can be sintered to pellets with densities ≤95% TD at ≤1800°C and several hours of sintering time. Nitrogen, hydrogen, mixtures of these gases (7 : 1), and argon have been used as sintering atmospheres. Density and composition are strongly dependent on sintering atmospheres and partial pressures. Oxygen contents of a few tenths of a percent occurring in the process do not interfere with sintering. Carbon contents of a few tenths of a percent enhance sintering. The simultaneous presence of oxygen and carbon in technical-grade UN results in a decrease of both elements as a result of CO formation, both temperatures around 1000°C, which are necessary for presintering, and during sintering (1600 to 1900°C); CO inhibits the sintering process. At low carbon contents, uranium dioxide in UN pellets is very effective in inhibiting grain growth. The addition of thorium metal at sintering temperatures above the melting point of thorium promotes sintering. It will combine with uranium dioxide so as to form a solid solution at the grain boundary wedges of UN; this does not impair the inhibition of grain growth by UO_2.

No free uranium is produced in the structure. Isothermal sintering of UN is not governed by a simple mechanism, at least not in a product contaminated with oxygen and carbon on a technical scale (a few tenths of a percent). The quaternary system U–N–O–C does not appear to be suited for sintering because of the impossibility of keeping the chemical composition constant during sintering. The transition from inhibition to promotion of sintering due to the oxygen content in the case of UN coincides with the transition from the single-phase U(N,O) solid solution to the two-phase mixture $UN + UO_2$. This is proved experimentally, and the possible causes are discussed. A model concept of an improvement of UN sintering by adding uranium dioxide is based on the assumption that a solid solution of $U_2N_3 \times UO_2$ will have better sintering properties than its basic components UO_2 and UN. The generation and disintegration of a solid solution of this type have been proven and explained. UO_2 addition to UN effectively inhibits grain growth during sintering. However, enhancing of the sintering process, could not be clearly observed by this effect. (auth)

25091 (KFK-1713) APPLICATION OF SINTERING THEORY IN PRACTICE. Topics for Discussion (Revised Form, Including Comments of ITS Members). Thuemmler, F. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Material und Festkoerperforschung). Dec 1972. 20p. (CONF-710978-1). Dep. NTIS (U. S. Sales Only).

From International team for studying sintering conference; Herceg Novi, Yugoslavia (6 Sep 1971).

Development of sintering theory and practice are reviewed. Discussions are included on quantitative and qualitative theories of sintering, recommendations for experimental research, pore geometrical parameters, cooperation between metallurgists and ceramists, and methods of narrowing the gap between research and practice. (JRD)

25092 (LA-5108) DETERMINATION OF TOTAL AMOUNT OF VOLATILES IN MIXED-OXIDE REACTOR FUEL PELLETS. Vance, D. E.; Smith, M. E.; Waterbury, G. R. (Los Alamos Scientific Lab., N. Mex.). Feb 1973. Contract W-7405-eng-36. 8p. Dep. NTIS $3.00.

Mixed-oxide reactor fuel pellets are heated inductively to 1600°C in a vacuum extraction apparatus to evolve the adsorbed volatiles which are measured volumetrically. Water vapor in the volatiles is removed by $Mg(ClO_4)_2$ dessicant, and the remaining gases are collected using a Toeppler pump. The pressure, volume, and temperature of the collected gases are measured, and the volume at standard conditions is calculated. The total amounts of volatiles measured other than water ranged between 0.020 and 0.059 cm^3/g for one lot of samples. A mass spectrometric study of the volatiles evolved from 200 to 1800°C identified H_2, He, CO, CO_2, N_2, NO, O_2, and Ar. (auth)

25093 (PNCT-841-72-26) COMPUTER SIMULATION OF NUCLEAR MATERIAL FLOW AND MUF IN THE PLUTONIUM FUEL PELLETIZING PROCESS. Aoki, M.; Masuda, S.; Mizuta, H. (Power Reactor and Nuclear Fuel Development Corp., Tokai (Japan)). Jul 1972. 57p. NTIS (U. S. Sales Only).

A computer-simulation code SASATSU, for nuclear material flow and material unaccounted for (MUF) has been programmed for analyzing the data of the ATR and Rapsodie campaigns in the present facility. With this simulation experience, the material flow characteristics in the FBR line of the new facility is estimated. (auth)

25094 (SRARI-P-152) TEMPERATURE MEASUREMENTS DURING THE IRRADIATION OF MATERIALS. Markina, N. V.; Samsonov, B. V. (Scientific Research Atomic Reactor Inst., Melekess (USSR)). 1972. 55p. (In Russian). Dep. NTIS (U. S. Sales Only) $4.75.

Temperature measurement techniques are considered for instrumented and uninstrumented reactors. Among the electrical methods, primary attention is directed to thermocouples. Information is given on thermocouple behavior under irradiation. Resistance thermometers are also considered. Non-electrical measurement methods such as fusible monitors, bimetallic and clinical thermometers, silicon carbide and diamond monitors, and "Temp-plug" sensors are discussed. (auth)

25095 NUCLEAR FUEL ELEMENT CONTAINING SINTERED URANIUM DIOXIDE FUEL WITH A FINE PARTICULATE DISPERSION OF AN OXIDE ADDITIVE THEREIN, AND METHOD OF MAKING SAME. Rigby, F.; Brian, J. (to United Kingdom Atomic Energy Authority). U. S. Patent 3,715,273. 6 Feb 1973. Priority date 16 Dec 1968, United Kingdom of Great Britain and Northern Ireland (UK). 6p.

Preparation of sintered uranium dioxide is described containing an additive of for example magnesium oxide or aluminum oxide, the additive being dispersed in fine particulate form within the grains of uranium dioxide. A method is also disclosed for preparing such a material in which the uranium dioxide containing the additive is sintered in an oxidizing atmosphere, for example 0 to 50% hydrogen in carbon dioxide to convert the material to a hyperstoichiometric uranium dioxide in which the additive is soluble. The material is then heated in a reducing atmosphere for example of hydrogen to convert the material to stoichiometric uranium dioxide in which the additive is insoluble and is released from solution in the material dispersed in fine particulate form within the grains of the uranium dioxide. (Official Gazette)

25096 METHOD FOR THE PREPARATION OF GRAINS. Noothout, A. J. (to Reactor Centrum Nederland). U. S. Patent 3,717,581. 20 Feb 1973. Priority date 6 Jan 1969, Netherlands. 10p.

A method is described for preparing particles of metal hydroxide gels by treating a concentrated aqueous solution of at least one hydrolyzable metal salt, the hydroxide of which is only slightly soluble in water, simultaneously with ammonia and heat. The solid substance thus obtained is separated, washed and heated thereby converting the solid substance to metal oxide particles. The hydrolyzable metal salt starting materials are concentrated solutions anion-deficient metal salt solutions, having a ratio of conjugated base to metal lower than that of the normal salt. When a nitrate-deficient uranyl nitrate solution is mixed with an ammonia-releasing agent, then dispersed in a hot phase immiscible with the aqueous phase, the resulting solidification produces microspheres of uranyl nitrate, which are useful as fuels for nuclear reactors. (auth)

25097 PROCESS FOR PREPARING IMPREGNATED URANIA AND URANIUM-BEARING MICROSPHERES. Triggiani, L. V.; Stone, I. C. (to W. R. Grace and Co.). U. S. Patent 3,714,061. 30 Jan 1973. Filed date 21 Mar 1969. 6p.

A process is described for preparing urania fuel particles in which the oxygen to uranium ratio is reduced to 2.0 by passing a reducing gas through a heated bed of the particles. (Official Gazette)

25098 COMPATIBILITY OF TANTALUM WITH GRAPHITE, UO_2, AND UC. Muraoka, S.; Itami, H.; Nomura, S. (Japan Atomic Energy Research Inst., Oarai). Nippon Genshiryoku Gakkaishi; 14: No. 11, 580-588(Nov 1972). (In Japanese).

The compatibility of Ta with graphite, UO_2, and UC at high temperature was studied in consideration of its impact on the safety aspects of capsule irradiation in the JMTR. It was revealed that Ta reacts with graphite above 1,200°C. Tantalum is compatible with UO_2 in the temperature range of 1400 ~ 2000°C. Tantalum, however, reacted with UC above 1400°C, and above 1600°C U penetrated into Ta. The reaction of Ta–C and Ta–UC, both manifested parabolic growth behavior of the reaction layers, which is indicative of diffusion-controlled reactions. The diffusion coefficients obtained from these experiments are: $D^C_{Ta_2C} = 1.7 \times 10^{-3} \exp(-26.0/RT) cm^2/sec$ (1400 ~ 1800°C), $D^C_{TaC} = 4.5 \exp(-103/RT) cm^2/sec$ (1800 ~ 2350°C), and $D^C_{Ta_2C} = 6.2 \times 10^2 \exp(-146/RT)$ cm^2/sec (1800 ~ 2350°C). (auth)

25099 METHOD OF PREPARATION OF SPHERIC PARTICLES (PELLETS). Schmidt, C. R. (to United States Atomic Energy Commission). German Patent 2,136,288. 27 Jan 1972. 11p. (In German).

Descriptions are presented concerning the preparation of carbon, graphite, or metal carbide particles in spherical or spheroid form, the size ranging from 40 to 600 μ. To a thermosetting resin (in particular partly polymerized furfuryl alcohol), a diluting agent (acetone), and a catalyst (maleic acid anhydride) are added until a viscosity of 2 to 200 centipoise is reached from which spherical droplets are sheared off and then caught in a suspension containing liquid (mineral oil). An addition of a wetting agent (sodium lauryl alcohol sulphate) prevents the agglomeration of the droplets until they have at least partly polymerized and become firm and self supporting. These are then heated to a sufficient temperature (1,000°C) in a carrier atmosphere to their charring point. The charred particles are graphitized through further heating. For the preparation of metal carbide particles the corresponding metal is added in soluble form (as a salt) or as an organometallic compound prior to the shearing of the fluid resin droplets. The sheared droplets are heated to temperatures between 1,600°C and 2,300°C to form the corresponding metal carbide. (GF)

25100 METHOD FOR THE PREPARATION OF URANIUM DIOXIDE–YTTRIUM OXIDE–ZIRCONIUM OXIDE MICROSPHERES. Smith, J. G.; Fitch, F. T. (to Grace (W. R.) and Co.). German Patent 1,667,095. 18 May 1972. 20p. (In German).

A procedure is described for the preparation of microspheres consisting of uranium dioxide–yttrium oxide–zirconium dioxide,

with an uranium dioxide content 30 to 55 (45) wt.%, an yttrium oxide content of 10 to 45(35.6) wt.%, and a zirconium dioxide content of 15 to 55(19.4) wt.%, with the values mentioned in brackets being of particular importance. According to this procedure, an ammonia-yielding substance (hexamethylenetetramine, acetamide, ammonium carbonate, ammonium carbamate, ammonium cyanate, urea alone or in a mixture) is mixed with a primary material consisting of a solution of soluble U^{+4}-, Y^{+3}- and $(ZrO)^{+2}$-salts, or of a uranium dioxide–yttrium oxide–zirconium dioxide aqua sol containing these salts in quantities up to the saturation concentration and the uranium, yttrium and zirconium compounds in stoichiometric quantities. The mixture is dropwise fed into a dehydrating solvent having a dissolving power for water of 1 to 30 wt.% at a temperature adequate for disintegrating the ammonia-yielding substance. The partly dehydrated microspheres are then separated from the dehydrating solvent. (GF)

25101 METHOD FOR THE PREPARATION OF SINTERED REFRACTORY PRODUCTS, PARTICULARLY NUCLEAR FUELS. Harrison, J. D. L.; Roberts, W. G. (to United Kingdom Atomic Energy Authority). German Patent 1,671,124. 27 Jan 1972. 10p. (In German).

Production processes are described for sintered bodies of plutonium carbide, thorium carbide, and mixtures of these compounds. The fine powder is produced by grinding the carbide in a pebble mill to a preferred grain size of $\leq 5\ \mu$. This stage of the overall process, just as the subsequent compacting of the fine powder and the sintering of the compact body, is performed in a noble-gas atmosphere of maximum purity, with the sintering being done in an atmosphere of greater purity (preferably argon with less than 2 ppM of oxygen and water vapor) than that of the preceding stages (argon with less than 20 ppM of oxygen and water vapor). The material is to be sintered at a temperature not exceeding 1,600°C. (GF)

25102 METHOD OF PREPARATION OF OXIDE AND CARBIDE NUCLEAR FUEL AND BREEDER MATERIAL PARTICLES FOR THE USE IN HIGH-TEMPERATURE REACTORS. Foerster, H.; Hackstein, K. G.; Kadner, M. (to Nuklear-Chemie und-Metallurgie GmbH). German Patent 2,037,232. 9 Mar 1972. 8p. (In German).

A process is described for preparation of spherical oxide or carbide fuel particles of uranium and/or thorium from the corresponding heavy metal salt solutions, by forming droplets, in particular by passing through a nozzle and solidifying these in alkaline ammoniacal precipitating baths. The heavy metal salt solutions contain organic polymer materials (preferably polyvinyl alcohol or its derivative) which bring about retarded precipitation of uranium and/or thorium compounds in the alkali (ammoniacal) precipitate bath and which simultaneously give rise to a maintenance over a sufficient period of time of the necessary surface tension compared with the precipitating medium for the formation of a fully spherical droplet. These organic substances can be precipitated out by solidifying and/or hardening the particles using alcohol, preferably iso- or n-propanol. These particles are then dried, calcined and sintered, i.e, melted. According to this process it can be advantageous to add oils, preferably paraffin oil, to the uranyl nitrile and/or thorium nitrate and polyvinyl alcohol containing solution for the formation of spherical particles. For the preparation of carbide particles the uranium and/or thorium and organic substance containing solution is displaced with soot and then formed into firm particles, which finally by reacting at temperatures of 1,800°C are converted to the carbide and were sintered and by raising the temperature to about 2,500°C are melted to dense particles of the corresponding heavy metal carbide. (GF)

25103 METHOD OF PREPARATION OF A PLUTONIUM OXIDE–URANIUM OXIDE CONTAINING FUEL FOR THE USE IN NUCLEAR REACTORS. Lyon, W. L. (to United States Atomic Energy Commission). German Patent 1,592,544. 9 Mar 1972. 11p. (In German).

A process for the preparation of a homogeneous plutonium oxide–uranium oxide fuel for nuclear reactors is described. To an acid solution containing plutonium and uranium salts in the form of uranyl nitrate and plutonium nitrate, with a mole ratio of plutonium to uranium of 1:1 in the solution, concentrated ammonium hydroxide is added to form a common precipitate of a mixture of plutonium hydroxide and uranium hydroxide. The precipitate obtained, which is easy to filter, wash and dry, is then heated in a stream of hydrogen at 700°C. The mixture is then mixed with uranium dioxide suitable for nuclear reactors in order to adjust the plutonium–uranium ratio in the fuel compound to a value suitable for nuclear reactors. (GF)

25104 GROWTH AND THERMAL ETCHING OF BORON CARBIDE. Motoc, C. (Polytechnical Inst., Bucharest); Constantinescu, F. J. Cryst. Growth; 18: No. 1, 29–33(Jan 1973).

Boron carbide crystals were obtained by a low-temperature (1450 to 1500°C) special procedure that allows a 60 to 70% conversion ratio of the initially contained boron into boron carbide. The reaction products were morphologically examined and subjected to thermal treatment in air or in high vacuum during different periods of time. (auth)

25105 NEW PARTIAL PHASE DIAGRAM FOR THE Nb–O SYSTEM. Marucco, J. F. (Paris Univ., Orsay, France). Compt. Rend., Ser. C; 275: No. 23, 1391–1394(6 Dec 1972). (In French).

The existence of two nonstoichiometric phases $NbO_{2.42}$ and $NbO_{2.47}$ was established and their stability regions defined from measurements of the partial pressure of oxygen in equilibrium with niobium oxides intermediate between NbO_2 and Nb_2O_5 in the temperature range 1000 to 1100°C. A new partial phase diagram was subsequently deduced for the NbO system. (France)

25106 STUDY OF THE STRUCTURE OF VANADIUM CARBIDES USING ELECTRON DIFFRACTION TECHNIQUES. Terao, N. (Univ., Louvain, Belg.). Compt. Rend., Ser. C.; 275: No. 20, 1165–1168(13 Nov 1972). (In French).

Thin films of vanadium carbide were prepared in two different phases: the cubic VC_{1-x} phase and the hexagonal V_2C phase. Electron-diffraction techniques were used to elucidate their structures. The existence of a V_2C superstructure was confirmed. (France)

25107 CRYSTALLINE STRUCTURE OF THE INTERMETALLIC COMPOUND $Ce_3Ni_2Si_8$. Stepien, J. A.; Lukaszewicz, K.; Hladyszewski, E. I.; Bodak, O. (Inst. of Low Temperatures and Structure Research, Warsaw). Bull. Acad. Pol. Sci., Ser. Sci. Chim., 20: No. 11-12, 1029-1036(1972).

Crystals of $Ce_3Ni_2Si_8$ are orthorhombic, space group C_{mmm}, with the two formula units in a cell, with the dimensions: a = 4.085 ± 0.02 Å, b = 25.9558 ± 0.0008 Å, c = 4.1786 ± 0.0009 Å, V = 443.10 Å^3, D_x = 5.714 g · cm^{-3}. All independent reflections 0kl, 1kl, and 2kl for MoK_α radiation were measured on a two-circle diffractometer. Corrections were made for absorption and anomalous dispersion. The structure was solved by Patterson and Fourier synthesis and refined by the least-squares method applying isotropic temperature factors and diagonal approximation to final R value of 10.31%. Atomic coordinates and temperature factors are: Ce(1)–2(a)–000, B = 0.31, Ce(2)–4(j)–y = 0.3162, B = 0.07, Ni–4(i)–y = 0.1335, B = 0.22, Si(1)–4(i)–y = 0.4077, B = 0.06, Si(2)–4(i)–y = 0.2240, B = 0.64, Si(3)–4(j)–y = 0.0941, B = –0.32, Si(4)–4(j)–y = 0.4534, B = –0.031. (auth)

25108 CRYSTAL GROWTH OF V_6O_{13}. Saeki, M.; Kimizuka, N.; Ishii, M.; Kawada, I.; Nakano, M.; Ichinose, A.; Nakahira, M. (National Inst. for Researches in Inorganic Materials, Kurakake, Japan). J. Cryst. Growth; 18: No. 1, 101–102(Jan 1973).

V_6O_{13} single crystals were prepared by chemical transport method. From the electrical measurements of these crystals, a semiconductor/semiconductor transition was found. Based on the crystallographic and electrical measurements, it is suggested that the transition is of the first order. (auth)

25109 ELECTRIC CONDUCTION OF BORON CARBIDE. Sugaya, T. (Ohkura Electric Co., Tokyo); Watanabe, O. Phys. Status Solidi (a): 15: No. 2, K181-K184(16 Feb 1973).

The electric conductivity of $B_{12}C_3$ single crystals containing excess boron was measured along ⟨001⟩, ⟨2$\bar{1}$0⟩, and ⟨1$\bar{1}$3⟩ axes in the temperature range 50 to 500°K. The conductivities along ⟨001⟩ and ⟨2$\bar{1}$0⟩ showed weak temperature dependence below 80°K, whereas along ⟨1$\bar{1}$3⟩ it showed $T^{6\cdot18}$ behavior. The conduction mechanism is discussed, and the excess boron atoms are considered as scattering centers. It is suggested that impurity and intrinsic conduction predominates in the low and high temperature regions, respectively. (DLC)

25110 CRYSTAL STRUCTURE OF THE MOLYBDENUM BORIDE $Mo_{1-x}B_3$. Lundstroem, T.; Rosenberg, I. (Uppsala Univ.). J. Solid State Chem.; 6: No. 2, 299-305(Feb 1973).

The structure of $Mo_{1-x}B_3$, with x close to 0.20, was investigated using powder diffractometry, in conjunction with the electron microprobe and chemical analysis. The range of homogeneity of the compound is very small and does not include the stoichiometric composition. The structure is described in the hexagonal space group $P6_3/mmc$ with the axes a = 5.2026 (2) Å and c = 6.3489 (3) Å. No significant variations in cell dimensions were observed. There are four formula units per unit cell with molybdenum at 2(b) (occupancy 60%) and 2(c) and boron at 12(i) with x = 0.333. The refinement was performed with least-squares and Fourier difference techniques. The final R value, based on intensities, was 8.8%. The

structure may be described as a stacking of two-dimensional boron nets and highly defect metal layers. The Mo–B distance exceeds the radius sum by 3%, while the Mo–Mo distances are 7 and 13% longer than the radius sum. There are holes in the structure, which are large enough to accommodate boron atoms. However, there is no evidence that these holes are even partially filled. (auth)

25111 STUDY OF THE PHASE DIAGRAM FORMED BETWEEN THORIUM DIOXIDE AND NEODYMIUM SESQUIOXIDE. Sibieude, F.; Coutures, J.; Foex, M. (CNRS, Montlouis, France). Compt. Rend., Ser. C; 275: No. 17, 941-944(23 Oct 1972). (In French).

In the phase diagram of the $ThO_2-Nd_2O_3$ system, the liquidus line is characterized by a discontinuity associated with the existence of peritectic (25 mole % of ThO_2). Beneath the solidus line, there exists two regions: a region corresponding to the dissolution of ThO_2 in Nd_2O_3 occurring in the A, H, and X forms; a region representing the solid solution of Nd_2O_3 in $ThO_2(C(ThO_2))$; in the middle of the diagram and above 1950°C, the double-phased regions $C(ThO_2)$ + X and $C(ThO_2)$ + A(or H) are observed, while beneath 1950°C a series of intermediate ordered phases are observed. (France)

25112 ELECTRICAL, MAGNETIC, AND OPTICAL CERAMICS. Conference held in London, December 13–14, 1972. London; British Ceramic Society (1972). 179p. (CONF-721216–). pounds 3.50.

From Conference on electrical magnetic and optical ceramics; London, UK (13 Dec 1972).

Twenty-four papers are included, which are arranged into four sections titled: ceramics for electrical insulation and conducting ceramics, magnetic ceramics, ceramics for thin films, and ferroelectric and optical ceramics. Three are considered in scope for NSA, and separate abstracts were prepared. (UK)

For abstracts of individual papers see: 25113 through 25115.

25113 ELECTRICAL CONDUCTANCE OF PURE YTTRIA AND THORIA DOPED YTTRIA. Biggs, A. (ITT Components Group, Taunton, Eng.); Dailly, D. F.; Waye, B. E. pp 44-48 of Electrical, Magnetic, and Optical Ceramics. London; British Ceramic Society (1972).

From Conference on electrical magnetic and optical ceramics; London, UK (13 Dec 1972). See CONF-271216–.

Pure yttrium oxide was compacted into discs and sintered to near theroretical density by a variety of processes, and its electrical conductance was measured at 1592 Hz over a temperature range 600 to 1400°C and over a wide range of oxygen partial pressures, using hydrogen–water mixtures. A similar series of experiments was conducted using Y_2O_3–1% thoria and Y_2O_3–10% thoria. The conductivity of Y_2O_3 was confirmed to be largely 'p' type at high partial pressures of oxygen and 'n' type at low oxygen partial pressures. The effect of added thoria was to create a region of constant conductivity over a wide range of oxygen partial pressures. This suggested an ionic mode of conductivity, resembling that of the thoria–yttria system in which thoria is the main constituent and yttria the dopant. (auth)

25114 BORON NITRIDE IN ELECTRICAL APPLICATIONS. Biddulph, R. H. pp 59-61 of Electrical, Magnetic, and Optical Ceramics. London; British Ceramic Society (1972).

From Conference on electrical magnetic and optical ceramics; London, UK (13 Dec 1972). See CONF-711216–.

The use of BN as an electrical insulator with a reasonably high thermal conductivity is discussed. The major application for such a material is to insulate a semiconductor device from its heat sink. Requirements include, in addition to high thermal conductivity, a high breakdown voltage, a high electrical resistivity, and high compressive strength. Possible materials are BN, BeO, and Al_2O_3, the properties of which are compared, and of these BN is satisfactory. (UK)

25115 ELECTRICAL PROPERTIES OF SOME COMMERCIAL BERYLLIA CERAMICS. George, W. (British Ceramic Research Association, Stoke-on-Trent, Eng.). pp 62-68 of Electrical, Magnetic, and Optical Ceramics. London; British Ceramic Society (1972).

From Conference on electrical magnetic and optical seramics; London, UK (13 Dec 1972). See CONF-721216–.

The electrical properties of a range of ceramics containing 93.5 to 99.9% BeO were evaluated. These properties were examined (a) after storage at room temperature for 24 hr in an atmosphere of 65% RH, (b) after treatment at 900°C for 2 hr in a vacuum of $<10^{-5}$ torr followed by treatment (a), and (c) after treatment at 1400°C for 2 hr in H_2 followed by treatment (a). Treatment (c) reduced release of BeO dust from the surface to a safe level. Results of permittivity, loss tangent, resistivity, and electric strength measurements are tabulated, together with density and chemical-analysis data. It was concluded that the combination of excellent dielectric properties and high thermal conductivity makes BeO ceramics ideal for such applications as valve windows and heat sinks. (UK)

25116 THERMAL DIFFUSIVITY AND THERMAL CONDUCTIVITY OF PYROLYTIC TITANIUM AND NIOBIUM CARBIDES AND TITANIUM NITRIDE AT HIGH TEMPERATURES. Fridlender, B. A.; Neshpor, V. S.; Ermakov, B. G.; Sokolov, V. V. (Inst. of Applied Chemistry, Leningrad). Inzh.-Fiz. Zh.; 24: No. 2, 294-296(Feb 1973). (In Russian).

It is shown that (a) and (λ) of TiC and NbC increase with temperature at 1500 to 2400°C. Thermal diffusivity of TiN is independent of temperature, and (λ) decreases with temperature increase at 1500 to 2200°C. (auth)

25117 DYNAMIC YIELD, COMPRESSIONAL, AND ELASTIC PARAMETERS FOR SEVERAL LIGHTWEIGHT INTERMETALLIC COMPOUNDS. Gust, W. H.; Holt, A. C.; Royce, E. B. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). J. Appl. Phys. 44: No. 2, 550-560 (Feb 1973).

Dynamic yield strengths, compression data under uniaxial shock-wave loading, and sonic velocities at 1 bar are reported for polycrystalline TiB_2, SiC, Be_4B, Be_4B+8 wt% BeO, Be_2B, AlB_{12}, $TiBe_{12}$, and $ZrBe_{13}$. Hugoniot elastic limits were measured as 86, 80, 74, 77, 65, 87, 53, and 71 kbar, respectively. Evidence of phase transitions was seen for the Be_4B materials at 500 kbar and for SiC at 240 and 960 kbar. (auth)

25118 CONDUCTION, PERMITTIVITY, INTERNAL PHOTOEMISSION, AND STRUCTURE OF ELECTRON-BEAM-EVAPORATED YTTRIUM OXIDE FILMS. Riemann, E.; Young, L. (Department of Electrical Engineering, The University of British Columbia, Vancouver 8, British Columbia, Canada). J. Appl. Phys. 44: No. 3, 1044-1049 (Mar 1973).

A study has been made of thin electron-beam-evaporated yttrium oxide films. The oxide structure was found to be polycrystalline, with grain sizes of the order of 100 Å, by electron microscopy. dc conduction measurements were made and a Frenkel-type of conduction mechanism was proposed. Step response and bridge dielectric loss measurements were compared. Internal photoemission was used to obtain metal/oxide barrier heights of 3.14 and 3.72 eV in an Al–Y_2O_3–Al structure. (auth)

25119 IN-PILE MIGRATION OF FISSION PRODUCT INCLUSIONS IN MIXED-OXIDE FUELS. Michels, L. C.; Poeppel, R. B. (Argonne National Laboratory, Materials Science Division, Argonne, Illinois 60439). J. Appl. Phys. 44: No. 3, 1003-1008 (Mar 1973).

Migration velocities of fission-gas bubbles and solid fission-product inclusions in uranium-plutonium mixed oxide under irradiation have been obtained. Trails behind migrating second-phase particles are observed upon etching a polished metallographic section from an irradiated fuel pin. It was determined from the microstructure and the reactor power history that these trails were produced during one reactor power cycle of known duration. Particle velocity was computed from the observed trail length and the duration of the power cycle. Velocities varied between 1 and 10 Å/sec for particles with diameters between 1 and 10μ. The temperature was between 1585 and 1850 °C, and the average temperature gradient was ≈5400 °C/cm. In all cases, the particles moved in the direction of increasing temperature. The measured velocities for both bubbles and solid inclusions are shown to be in agreement with the calculated velocities based on a surface-diffusion mechanism with Q_s^*, the surface heat of transport, equal to 100 kcal/mole. (auth)

25120 MICROSTRUCTURAL DEVELOPMENT DURING THE LIQUID-PHASE SINTERING OF VC–Co ALLOYS. Warren, R. (Surrey Univ., Guilford, Eng.). J. Mater. Sci.; 7: No. 12, 1434-1442(Dec 1972).

A study was made of the microstructural changes that occur during the liquid-phase sintering of VC–Co alloys. It was found that considerable growth of the carbide grains takes place and that this growth can be described by the equation: $\bar{d}^3 - \bar{d}_0^3 = Kt$. The value of the rate constant, K, at 1450°C was found to be in good agreement with that predicted by a modified Wagner analysis for a solution/precipitation process controlled by diffusion through the liquid. The observed variations in the growth rate both with temperature, between 1380 and 1500°C, and with the volume fraction of the liquid phase are also consistent with this theory. The contiguity of the carbide grains at the start of sintering is relatively high and is affected by the pre-sintering history of the specimen. During the early stages of sintering, however, the contiguity falls rapidly to a low value which subsequently remains relatively constant. Observations were made which suggest that the carbide does not form a continuous skeleton during sintering. (auth)

25121 WELDING STEEL Kh18N9T TO VANADIUM. Gonservoskii, F. G. Avtomat. Svarka; No. 4, 63-65(Apr 1972). (In Russian).

Welding was achieved in vacuum with inductive and radiative heating and at various contacting pressures from 2 to 7 kg/mm^2. A second technique involved welding under extreme contacting pressure in a special stainless steel, sealed container. The compositions of metal at and around the joints obtained were compared. Tube samples were made up by the second method and subjected to mechanical and air-tightness testing. The butt welds produced were satisfactory. (Metals Abstr.)

25122 THERMAL CONDUCTIVITY OF URANIUM DIOXIDE AND OF URANIUM–PLUTONIUM DIOXIDES AT HIGH TEMPERATURES. Schmidt, H. E. Forsch. Ingenieurw.; 38: No. 5, 149-151(1972). (In German).

A new equation has been formed to enable the calculation of the thermal conductivity of uranium dioxide and of uranium–plutonium dioxide in a high-temperature region from the measured values of the specific capacity. The necessary parameters to evaluate the equation are given in a table. For different oxygen concentrations of the mixed oxide, calculated heat coefficients agree well with the measured values. (GF)

25123 THERMAL EXPANSION OF THE OXIDES OF CERIUM, PRASEODYMIUM, AND ERBIUM BY X-RAY-DIFFRACTION METHOD. Hatibarua, J.; Mahanta, P. C. (Gauhati Univ., India). Indian J. Pure Appl. Phys.; 10: No. 8, 599-601(Aug 1972).

Results of measurements of the thermal expansion of powder samples of the oxides of cerium, praseodymium, and erbium in the range 77 to 1300°K are reported. For GeO_2, a λ transition at $T \approx 400$°K and an abnormal expansion from 750°K were observed. The abnormal expansion is attributed to the removal of oxygen from the crystal. The activation energies of the two processes were found to be 0.16 eV; respectively. No new phase was observed for praseodymium oxides. The activation energy for the removal of an oxygen atom from PrO_2 of fluorite structure to transform it to a reduced Pr_6O_{11} of the same structure was found to be ≈1.1 eV. The abnormal increase in the thermal expansion of Er_2O_3 from about 1200°K is attributed to the self-diffusion of oxygen atoms in the structure, the activation energy being 3.4 eV. (auth)

25124 EFFECT OF THE ATMOSPHERE ON URANIUM DIOXIDE SINTERING IN THE TEMPERATURE RANGE 900 TO 1200°C. Kostic, E.; Petrovic, V.; Ristic, M. M. (Boris Kidric Inst. of Nuclear Sciences, Belgrade). Sprechsaal Keram. Glas Email Silikate; 104: No. 24, 1081-1084(1971).

Pressed UO_2-powder samples were sintered at temperatures of 900, 1000, 1100, and 1200°C, respectively, in dry hydrogen, helium, and vacuum. The sintered samples have been characterized by measuring of porosity, shapes and sizes of pores and grains, and by studying the types of fracture surface. The atmosphere of sintering had a crucial effect on the formation of definite porosity type in pellets of uranium dioxide. A discussion is given on the effect of the U/O ratio on the densification process and on the obtained values of diffusion coefficients of U^{4+}-ion. (INIS)

25125 SINTERED NUCLEAR FUEL CONTAINING A BURNABLE NUCLEAR POISON AND PROCESS FOR ITS PREPARATION. (to Fiat SpA). Belgian Patent 743,232. 16 Dec 1969. Priority date 25 Feb 1969, Italy.

A sintered nuclear fuel, especially sintered uranium dioxide, containing a burnable nuclear poison is characterized by the fact that the burnable poison is uniformly distributed in the form of microspheres of 10 to 2000 microns in the nuclear fuel. (BE)

Metals and Alloys

Corrosion and Erosion

Refer also to abstracts 25085, 25098, and 26748.

25126 (AD-867061) CORROSION CRACKING OF METALLIC MATERIALS. Technical Report, 15 December 1968–31 December 1969. Fontana, M. G. (Ohio State Univ., Columbus. Dept. of Metallurgical Engineering). Jan 1970. Contract F33615-69-C-1258. 210p. (AFML-TR-70-2). NTIS.

Stress-corrosion behavior of titanium alloys and high-strength steels was studied. In titanium alloys the initiation and propagation of cracks in aqueous and methanolic environments was studied as a function of alloy composition, electrochemical control, and applied stress. Corrosion processes within crevices were studied. Straining electrode studies are also reported. In high-strength steels the processes of transient passivity, dissolution of carbides, crack propagation, and hydrogen permeation were studied. The kinetics of transient passivity on iron-alloy surfaces shows good agreement with classic models for growth of thin films. (NTIS)

25127 (AECL-4140) THERMODYNAMICS OF METAL OXIDES IN WATER-COOLED NUCLEAR REACTORS. MacDonald, D. D.; Rummery, T. E. (Atomic Energy of Canada Ltd., Pinawa (Manitoba). Whiteshell Nuclear Research Establishment). Jan 1973. 27p. Dep. NTIS (U. S. Sales Only) $3.50.

The thermodynamics of oxidation of metals and reduction of metal oxides in aqueous systems containing dissolved hydrogen and oxygen at temperatures to 300°C are examined. The data are presented as equilibrium partial pressures of oxygen and hydrogen for specific reactions. This information is used to predict which solids are stable in an equilibrium system containing known concentrations of oxygen and hydrogen. In the presence of γ and neutron radiation fields, the concentrations of hydrogen and oxygen are much greater than the equilibrium values, and both the oxidized and reduced forms of a metal can be formed spontaneously. The relative amounts of each form depend upon the kinetics of the oxidation and reduction reactions. X-ray-diffraction data of deposits removed from the heat transport system of the Douglas Point Generating Station are discussed with respect to the kinetics of the oxidation–reduction processes. (auth)

25128 (BNWL-9) ALUMINUM AND STEEL CORROSION IN LOW pH WATER AT D-REACTOR. FitzPatrick, V. F.; Richman, R. B. (Battelle Pacific Northwest Labs., Richland, Wash.). Jan 1965. Contract AT(45-1)-1830. 18p. Dep. NTIS $3.00. Declassified 2 Apr 1973.

The uniform corrosion rate of aluminum was decreased by reducing the pH of treated Columbia River water from pH 7.0 to pH 6.2 during two half-plant tests conducted at D-Reactor. A slight increase in carbon steel corrosion was measured for this same pH change. The first test was pH 6.6 with a control of pH 7.0 and the second was pH 6.2 with a control of pH 6.6. The dichromate addition was 1.8 ppM in the first test and 1.4 ppM in the second test. The results of these tests demonstrate that use of treated water pH values as low as 6.2 would significantly reduce uniform corrosion of aluminum reactor components. The corrosion of carbon steel components would be slightly increased at the lower pH values, but long-term in-plant measurements are needed to closely define the effects of pH reduction on corrosion of carbon steel components. (auth)

25129 HIGH-TEMPERATURE OXIDATION AND MODIFICATION OF SILICIDE COATINGS ON MOLYBDENUM. Byalobzheskii, A. V.; Krasilov, B. I.; Tsirlin, B. I. (Inst. of Physical Chemistry, Moscow). Zashch. Metal.; 8: No. 3, 273-276(May 1972). (In Russian).

Silicide coatings on Mo and its industrial alloys were tested at 1355 to 1500°C in air and then examined by weight difference, chemical, metallographical, and x-ray techniques. The kinetics of corrosive decomposition of the silicide coatings on Mo and its alloys were variable in character with temperature. Possible mechanisms are discussed. Methods for producing the coatings and a boride modification were developed. (tr-auth).

25130 CORROSION RESISTANCE AND ELECTROCHEMICAL AND MECHANICAL PROPERTIES OF TRINARY Nb–Ti–Ta AND Nb–Ti–Cr ALLOYS. Andreeva, V. V.; Glukhova, A. I.; Dontsov, S. N.; Moiseeva, I. S.; Mel'nikova, L. V. Zashch. Metal.; No. 4, 415-419(1972). (In Russian).

Binary alloys of Nb + Ta are highly resistant to solutions of strong acids. These alloys are quite promising for the manufacture of important parts of chemical apparatus. It was assumed that the presence of tantalum in binary Nb–Ti alloys should increase their corrosion resistance without reducing mechanical and technological characteristics. An experimental study was therefore made of the influence of the individual elements on the corrosion resistance and electrochemical and mechanical properties of certain ternary niobium-based alloys with titanium, tantalum, and chromium. The corrosion resistance of Nb–Ti–Ta alloys in solutions of sulfuric and hydrochloric acid at 100°C decreases with increasing titanium content, with tantalum content remaining constant. The addition of 1 to 5% chromium to niobium has no influence on its resistance to these acids, but reduces workability in the hot and cold states. Addition of chromium to Nb–Ti alloys can produce alloys with good technological properties. The chromium significantly increases the strength characteristics at high temperatures. Addition of chromium also increases the hardness of case alloys. Dendritic liquation occurs in alloys containing 30 and 40% Ti and 4 to 5% Cr. Addition of up to 5% chromium to Nb–Ti alloys does not decrease acid resistance, but improves mechanical characteristics. (auth)

25131 CORROSION RESISTANCE OF TWO- AND THREE-COMPONENT VANADIUM ALLOYS IN BOILING SOLUTIONS

OF INORGANIC ACIDS. Vorob'eva, L. P.; Druzhinina, I. P.; Gulyaev, A. P. Nauch. Tr., Gos. Nauch.-Issled. Proekt. Inst. Redkometal. Prom.; 32: 168-174(1971). (In Russian).

The corrosion rate of V and V alloyed with Ti, Ta, Mo, and W was determined in boiling solutions of HCl, H_2SO_4, H_3PO_4, and HNO_3 of various concentrations. Complete stability of alloy to a specific concentration of acid can be achieved by using an adequate amount of alloying element. (Corros. Abstr.)

25132 CORROSION OF EP-496 NICKEL–MOLYBDENUM ALLOY IN HYDROCHLORIC ACID SOLUTIONS CONTAINING FLUORIDE IONS. Matusevich, V. S.; Lebedev, A. N.; Fokin, M. M.; Konstantinova, E. V. Zashch. Metal.; 8: No. 3, 317-320 (May 1972). (In Russian).

During a search for corrosion-resistant alloys that could withstand a $HCl-HF-H_2O$ mixture, tests were made of the Ni–Mo alloy EP-496: C < 0.05, Si < 0.5, V ~ 1.5, Fe < 4.0, Mo from 25 to 29%, and the remainder = Ni. The test solutions were 10M HCl with added F^- (0.2 to 1.0M) at the boiling temperature of 104°C. The corrosion rate increased sharply with increased concentration of Fe^{3+}, and a search was instituted for a suitable reducing agent for minimizing Fe^{3+} concentrations in solution. Metallic Ti proved to be a very effective inhibitor of corrosion for the alloy EP-496 in a Cl^-/F^- medium, lowering the corrosion rate from 0.47 to 0.04 $g/m^2 \cdot hr$. (tr auth)

25133 SURFACE REACTION OF TITANIUM AND ZIRCONIUM AT HIGH TEMPERATURE AND LOW PRESSURE. Nagasaka, M.; Yamashina, T. (Hokkaido Univ., Sapporo). Nippon Kinzoku Gakkai Kaiho; 11: No. 9, 639-648(Sep 1972). (In Japanese)

Reaction mechanisms of titanium and zirconium reacting with gas under low pressure are described along with techniques for measuring the reactions under these conditions. Results of experiments in which the oxidation reaction of a titanium foil 50 cm^2 in area and 0.03 mm in thickness was measured at oxygen pressure 4×10^{-6} to 1×10^{-3} torr and temperature 500 to 800°C show that when the pressure is sufficiently low, the reaction conforms to the linear rate law, and when the pressure is higher than 4×10^{-4} torr, it conforms to the parabolic rate law, during reaction time of 300 min. The oxidation reaction of zirconium under low pressure conformed initially to the linear rate law, but eventually to the parabolic rate law. Descriptions are included on effects of change in the pressure and temperature on the same experiment, effects on other experiments by volumetric methods, characteristics of linear law reaction, and the reaction mechanisms. In order to solve these problems, it is necessary to devote effort to clarifying the cause and effect relation of "solid structure and chemical reactivity" on the basis of summarized information by observing directly the variation of the solid structure due to adsorption, reaction on the surface of oxide, and the surface composition. An approach employing the kinetic theory is also used. (Japan)

25134 RUST PREVENTIVE COMPOSITIONS. Jones, E. F. (to Esso Research and Engineering Co.). British Patent 1,296,662. 15 Nov 1972. Filed date 12 Feb 1970. 2p.

It is stated that the use of a rust-preventing composition containing sodium sulfonates and lanolin has been found unsatisfactory for the protection of stressing tendons in the concrete shield of nuclear reactors; stray electrical currents and the presence of water in the ducts cause the composition to emulsify, and pitting results. A composition is described which does not show this disadvantage; it comprises a mixture of petroleum or other wax, a metal naphthenate, and an ester formed from a polyol, and a natural fatty body; a diluent such as lubricating oil or white spirit may also be present. The ester may be derived from sorbitan, mannitan, pentaerythritol, trimethylol propane, or other polyhydric alcohols preferably having no more than eight C atoms per molecule, and the fatty body may be lanolin, wool grease, tallow, or castor oil, but the preferred ester is the pentaerythritol ester of lanolin. Preferred quantities of the components are indicated. Antioxidants may be included. (UK)

25135 ELECTROCHEMICAL PROPERTIES OF HETEROGENEOUS ALLOYS. Titova, I. E.; Novikova, L. V.; Zakharova, T. A.; Novgorodova, G. F. Zashch. Metal.; 8: No. 3, 334-335 (1972). (In Russian).

Weight-loss measurements were used to study the corrosion resistance of pure metals and their alloys in HCl and H_2SO_4 with polarization methods to determine the kinetics of the electrode processes. Experimental data are given for Cd–Pb, Ga–Sn, Zn–Cd, Zn–Sb, Ga–Zn, and Cd–Ga alloys. Anodic polarization of the alloys was less and the corrosion rates higher than for the unalloyed metals. It is considered that the electrochemical behavior of these heterogeneous alloys is determined by the nonadditivity of anodic effectiveness and in less extent by the H overvoltage effects of the alloy components, since this should result in reduction of the corrosion rate by additions of Sn to Ga, Cd to Zn, or Pb to Cd. (Metals Abstr.)

25136 CORROSION OF ZIRCALOY-2 COOLED FROM BETA-PHASE TEMPERATURE WITH DIFFERENT COOLING RATES, IN HOT WATER AND STEAM ENVIRONMENT. Ueki, I.; Kagawa, M.; Akiyama, H. (Mitsubishi Atomic Power Industries, Inc., Tokyo). Nippon Genshiryoku Gakkaishi; 14: No. 11, 589-596 (Nov 1972).

Zircaloy-2 specimens were immersed in water at 360°C under 190 kg/cm^2 and in steam at 400°C under 100 kg/cm^2 up to 175 days, and their behavior was evaluated by weight-gain measurements and metallographic examination. Results show that for as-cooled Zircaloy, the effect of differences in cooling rate on the corrosion weight gain is found only in the early stages of steam corrosion, and this is attributed to blistering of the oxide films found between the grain boundaries on the surfaces of the alloy. Preferential oxidation of grain boundaries is found on as-cooled specimens corroded in water, and this is attributed to galvanic-type corrosion accelerated by local dilution of the solute elements around the precipitates on the grain boundaries. The "breakaway" phenomena in Zircaloy corrosion kinetics is explained in terms of the mechanical detachment of the protective oxide films from the alloy surfaces by stresses that arise during film growth and rapid propagation of this cleavage favored by the change occasioned on the microstructure of the oxide films. Among the alloying elements of Zircaloy-2, Fe, Cr, and Ni are found to precipitate with Zr as intermetallic compounds, thus forming discontinuities on the oxide film, and these elements consequently contribute to relieving the stresses and to improving the corrosion resistance of the alloy. (auth)

Preparation and Fabrication

Refer also to abstracts 24558, 25093, and 25265.

25137 (AD-867457) DEVELOPMENT OF BERYLLIUM ALLOYS FOR HIGH-STRENGTH BERYLLIUM WIRES. Final Technical Report, 1 July 1967–30 June 1969. Hurd, J. N.; Lohrer, R. J.; O'Rourke, R. G. (Brush Beryllium Co., Cleveland, Ohio). Feb 1970. Contract F33615-67-C-1691. 165p. (BBC-TR-451-258; AFML-TR-69-306). NTIS.

Results of a program designed to produce 5-mil-dia beryllium wire of strength near 300,000 psi are described. It consisted of drawing wire from two starting materials, powder of a thermally reduced origin and powder of an electrorefined origin. Various hot-pressed grain sizes and alloying with low amounts of Fe, Co, or Cu, to produce intermetallic dispersion and/or solid solution alloys were used. (NTIS)

25138 (AD-872186) DIFFUSION WELDING OF WROUGHT BERYLLIUM. Final Technical Report, 15 April 1969–14 April 1970. Hauser, D.; Howden, D. G.; Monroe, R. E. (Battelle Memorial Inst., Columbus, Ohio). Jun 1970. Contract F33615-69-C-1621. 75p. (AFML-TR-70-143). NTIS.

A study was conducted on production of diffusion welds in wrought beryllium sheet having tensile strength, approaching those of the base metal at temperatures up to 800°F. Beryllium sheet, $\frac{1}{16}$ to $\frac{1}{4}$ inch thick and containing 1 to 2% BeO, was butt welded in vacuum at about 10^{-6} torr. Welds made in the low-oxide, $\frac{1}{8}$-inch-thick sheet at 1550°F for $1\frac{3}{4}$ hours with 5 to 10% deformation after etching in an HNO_3-HF-H_2O solution had a yield-strength efficiency of 93% at room temperature and 98% at 800°F. Tensile elongation in 1 inch was less than 1% at room temperature and 10%, or a third of the base-metal elongation, at 800°F. (NTIS)

25139 (BNWL-17) COEXTRUSION OF ALUMINUM-CLAD Li–Al TARGET MATERIAL. Ard, P. A. (Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.). Jan 1965. Contract AT(45-1)-1830. 29p. Dep. NTIS $3.50.

Declassified 3 Apr 1973.

Results of studies of coextrusions indicate that an aluminum clad target material can be consistently coextruded with a uniform clad thickness and a smooth external surface. The use of a good billet and die lubricant is necessary for a good extrusion surface. A tenacious coat of Aquadag on the billet and a mixture of Bentonite Grease and lead fines for die lubricant has been found to provide adequate lubrication. The condition of the extrusion die was found to be very important. Extrusion speed seems to have very little effect on preventing die pick-up. Primary extrusion of the cast Li–Al material followed by recrystallization appears to provide a smoother interface between clad and core. Target materials containing up through 1.3% Li have been primary extruded at a 3.64 area reduction with no billet preheat using the same extru-

sion lubrication procedure used for coextrusion. Higher reductions or materials containing lithium percentages high enough to produce second phases in the material require preheating of the billets; the temperature depending upon the Li content. To prevent serious contamination of the material during preheat and to aid extrusion, the billet should be canned in thin aluminum for the extrusion. The production of the clad target material at area reductions much over 21 to 1 requires billet interface preparation to prevent clad to core bonding in the extrusion. Bonding was found to be very prevalent at reductions of 34 to 1. Dry blasting both the internal surface of the billet can and the OD surface of the core material followed by rubbing the powdered graphite onto both surfaces appears adequate to prevent bond at the reductions required. (auth)

25140 (RDT-C-17-5-T(2-73)) METAL-SHEATHED, MINERAL INSULATED CABLE BULK MATERIAL. (Division of Reactor Development and Technology (AEC), Washington, D. C.). Feb 1973. 10p. RSO.

A standard prescribing requirements for metal-sheathed mineral insulated cable bulk material for nuclear and associated applications is presented. (JRD)

25141 (RDT-M-7-4-T(2-73)) NICKEL–CHROMIUM–IRON ALLOY ROD AND BAR (ASME SB-166 WITH ADDITIONAL REQUIREMENTS). (DIVISION OF REACTOR DEVELOPMENT AND TECHNOLOGY (AEC), WASHINGTON, D. C.). Feb 1973. 7p. RSO.

A standard prescribing requirements for nickel–chromium–iron alloy rod and bar (ASME SB-166 with additional requirements) for nuclear and associated applications is presented. This standard supersedes RDT M 7-4T, dated July 1971. (JRD)

25142 (UCRL-74340) PLUTONIUM FOUNDRY PRACTICES AT THE LAWRENCE LIVERMORE LABORATORY. Rose, R. L. (California Univ., Livermore. Lawrence Livermore Lab.). 27 Dec 1972. 22p. (CONF-730408-1).

From American Foundrymen's Society casting congress meeting; Montreal, Quebec B. C., Canada (30 Apr 1973).

A foundry has been constructed for the production of plutonium and plutonium-rich alloy castings in a variety of shapes and sizes. The foundry consists of two vacuum-induction casting units, one arc-casting unit, and gloved, negative-pressure, argon-filled work boxes to facilitate all foundry operations. The design and operation of the foundry equipment is done under the strictest of guidelines because of the hazardous nature of plutonium. Plutonium is a highly radiotoxic material and personnel must be protected from its radiation. Since plutonium decays by alpha particle emission, normal gloved box operations protect the operator from any serious external radiation hazard. However, it is biologically a very hazardous material once it enters the body because it is a bone seeker and has a relatively long biological half-life. Normal plutonium metal (which contains approximately 93% of the ^{239}Pu isotope) is a fissile material which will undergo a self-sustaining nuclear chain reaction and reach uncontrolled criticality, in the proper shape and mass, with the concurrent release of large amounts of heat and radiation. Due to its fissile nature, strict geometry and administrative controls have to be maintained for plutonium handling. It is also chemically a very reactive element and in finely divided form is pyrophoric. Because of these properties and the growing requirements from all concerned government agencies to increase operator and facility safety in radioactive materials operations, the most conservative of approaches was taken in the design of equipment and work areas. The foundry was used to exert close control over product quality and characterization, and was also used in preparation of alloys for research programs. This foundry is capable of meeting the ever-increasing demand for plutonium-base materials for laboratory research and development programs. (auth)

25143 EFFECT OF SURFACE PREPARATION ON THE FORMATION OF A SOLID JOINT IN ALLOY VNZ BY DIFFUSION WELDING IN VACUUM. Abramtsev, A. V.; Kedrin, I. D.; Nichushkin, V. V. Svar. Proizv.; No. 5, 23-24(May 1972). (In Russian).

The Nb alloy (containing Mo 4.0 to 5.2, Zr 0.8 to 2.0, and C 0.08 to 0.16%) was diffusion welded using a Ni packing. The surfaces were vacuum-arctreated. The treatment of the surfaces was also accomplished using powdered nickel. The crystalline structure and phase constitution of the joints obtained are discussed in detail. (Metals Abstr.)

25144 MECHANICAL PROPERTIES AND RELATED FEATURES OF ZIRCALOY TUBING. Konishi, T.; Matsuda, K.; Teranishi, H. Sumitomo Search; No. 6, 70-80(Nov 1971).

The effects of conditions of manufacture (O content, cold reduction, and Q value (ratio of reduction in thickness to that of internal dia)) on the mechanical properties of Zircaloy tubing were studied. Alloying elements and impurities satisfied Zircaloy-2 specification (except for O content). Cold reduction of 25 samples was carried out on a Pilger mill followed by drawing. Scribed circles on tubes revealed the nature of the deformation. O contents ranged from 600 to 1700 ppM. Experiments are reported in which the texture was measured by (0002) pole figures on the outer surface by Cfr-Kα reflection, as are tensile tests and bursting tests on closed and open-end tubes at ordinary temperature and 343°C. Conclusions were: strength can be adjusted by controlling O content, but O content cannot be used in relating mechanical properties and Q value; cold reduction has little effect on texture, which is shown by orientation of hydride platelets and is decided by Q (final) value; high Q value tubes show little reduction in thickness but in low Q tubes reduction in thickness and axial contraction contribute to circumferential elongation; and mechanical properties in the axial direction are improved in high Q tubes. (Metals Abstr.)

25145 EFFECT OF HEAT TREATMENT ON THE PROPERTIES OF THE ALLOY SYSTEM MOLYBDENUM–CARBON–NICKEL AND ITS COMPOUNDS. Alekseenko, G. N. Avtomat. Svarka; No. 4, 47-49(Apr 1972). (In Russian).

Molybdenum alloy samples with C 0.05 to 0.10% and Ni 0.01 to 0.10% were obtained as rods or rolled as sheet. Sheet samples were arc-welded in an inert atmosphere. Samples were then studied before annealing and after annealing in vacuum for 1 hr at 800 to 1700°C. Mechanical properties were correlated with alloying element contents and annealing temperature, and samples were studied microstructurally. (Metals Abstr.)

25146 NEW WORKABLE WEAR IN RESISTANT ALLOYS. Sol'ts, V. A.; Byadretdinova, M. A. Sb. Tr. Tsent. Nauch. Issled. Inst. Chern. Met.; No. 78, 139-146(1971). (In Russian).

Mechanical, physical, and wear-resistant properties are reported for some Co-base alloys and for new workable alloys of the 45KKhVN (Co–Cr–W–Ni) classification, containing 15 or 20% W. The latter are proposed for the writing elements of fountain pens. Their wear resistance is reduced as the degree of deformation is increased and, with deformation, the temperature at which the two alloys show the greatest wear resistance and hardness do not coincide. The 20% W alloy has better wear resistance than cast stellite for the application considered. (Metals Abstr.)

25147 INTERFACE ZONE IN THE STEEL/NIOBIUM BIMETAL. Kudinov, V. M.; Shevchuk, T. V.; Kharchenko, G. K.; Berezina, N. V. Avtomat. Svarka; No. 8, 71-72(Aug 1972). (In Russian).

Armco iron, steel 34KhN3M, steel Okh17T, and steel 1Kh18N9T were explosively welded to niobium. The interface was studied microstructurally and microhardness recorded after various annealing treatments. Annealing progressively increases the width of the interface zone. (Metals Abstr.)

25148 STRENGTH OF WELDED JOINTS IN NIOBIUM UNDER ALTERNATING LOAD. Gurevich, S. M.; Nerodenko, M. M.; Asnis, E. A.; Smirnov, S. V.; Rabkina, M. D. Avtomat. Svarka; No. 7, 32-34(Jul 1972). (In Russian).

Samples of Nb in the form of 2-mm sheet and 28-mm-dia tube of wall thickness 1 mm were Ar-arc welded using nonfusible electrodes. The fatigue strength of the welded samples was measured. The effect of grinding down the weld and the effect of annealing for 1 h at 1200°C were recorded. Microstructural phenomena are discussed. Annealing is beneficial, grinding of limited value. Alloying with V and Zr enhances fatigue strength. (Metals Abstr.)

25149 OBTAINING A THERMALLY STABLE TUNGSTEN/COPPER JOINT. Ponomarenko, E. P.; Panfilova, S. Ya.; Plyshevskii, A. I.; Romanovskii, V. F.; El'kin, N. V. Avtomat. Svarka; No. 6, 60-62(Jun 1972). (In Russian).

W/Cu joints were fabricated by diffusion welding and by contact-reactive joining. Various packings and foils were used, in some cases applied to one of the surfaces by vacuum deposition. Concentration and microhardness profiles across the joints are presented, and the microstructures discussed in detail. (Metals Abstr.)

25150 DEEP-DRAWING PROPERTIES OF THIN SHEETS OF TECHNICALLY PURE MOLYBDENUM AND ITS ALLOYS. Korolev, V. N.; Galakhov, A. I. Kuznechno-Shtampovochnoe Proizvod.; No. 3, 18-20(Mar 1972). (In Russian).

Results of an investigation into the deep drawing of thin sheets (0.30 to 0.82 mm) of technically pure Mo (designation MCh) and two Mo alloys (TsM-2A and VM-1) are presented. (Metals Abstr.)

25151 ALIGNED EUTECTIC THIN-FILM GROWTH. Albers, W.; Van Hoof, L. (Philips Research Labs., Eindhoven, Netherlands). J. Cryst. Growth; 18: No. 2, 147-150(Feb 1973).

Thin aligned eutectic films were grown in situ by withdrawing a silica loop or a silica slide from a eutectic melt. For the Cd–Zn eutectic, the lamellae were aligned parallel to the pulling di-

rection and for thicknesses less than about 50 μm also perpendicular to the lateral film surfaces. The crystallographic relationship between the constituent phases as well as the orientation with respect to the pulling direction was determined. The relationship between the interlamellar period λ and the pulling rate is discussed. (auth)

25152 GROWTH OF $SmCo_5$ CRYSTALS BY THE BRIDGMAN TECHNIQUE. Miller, J. F.; Austin, A. E. (Battelle Memorial Inst., Columbus, OH). J. Cryst. Growth; 18: No. 1, 7-12(Jan 1973).

A method was developed for the growth of $SmCo_5$ crystals which consistently yields large crystals (up to about 100 g and up to 2 cm dimensions). Growth is by directional solidification of a samarium-rich melt by the Bridgman technique at a rate ≤1 mm/h. (auth)

25153 RESEARCHES IN POWDER METALLURGY. Volume 2. Borok, B. A. (ed.). New York; Plenum Publishing Corporation (1972). 132p.

Translation of Poroshkovaya Metallurgiya by Z. S. Michalewicz.

Thirty papers are included in the volume. A separate abstract was prepared for each of six papers selected as being in the scope of NSA. One paper was previously abstracted in NSA as 25: 58248. (JRD)

For abstracts of individual papers see: 25154–25158, and 25217.

25154 HOT EXTRUSION AND PROPERTIES OF RODS FROM SINTERED MOLYBDENUM AND TUNGSTEN BLANKS. Manegin, Yu. V.; Yasinskaya, V. S.; Savin, A. V.; Fedorov, Yu. K. pp 87-90 of Researches in Powder Metallurgy. Vol. 2. Borok, B. A. (ed.). New York; Plenum Publishing Corp. (1972).

The workability of sintered Mo and W blanks under hot-extrusion conditions were studied. It was found that sintered molybdenum and tungsten blanks can be hot-worked by extrusion; molybdenum at 750 to 1600°C and tungsten at 1200 to 1700°C. The limiting elongation coefficients for these temperatures are, respectively, 6 to 22 and 2.5 to 5. During extrusion, the starting grain undergoes comminution. The hardness after extrusion is higher than in the initial condition. To ensure good mechanical properties in hot-extruded molybdenum rods, extrusion should be performed at temperatures not exceeding 900°C and the resulting rods should be annealed for 1 h at 900°C. (auth)

25155 EFFECT OF HIGH ISOSTATIC PRESSURES ON THE COMPRESSIBILITY AND SINTERABILITY OF TUNGSTEN POWDERS. Dzneladze, Zh. I.; Ershova, I. O.; Lobashev, B. P.; Il'in, G. A.; Maksimov, L. Yu. pp 95-99 of Researches in Powder Metallurgy. Vol. 2. Borok, B. A. (Ed.). New York; Plenum Publishing Corp. (1972).

As a result of investigations into the effect of isostatic compaction pressure in the range 9 to 190 kg/mm² on the compressibility and sinterability of three tungsten powder grades it has been established that the plot of the log ν vs log p function is a straight line at all pressures up to 100 to 130 kg/mm², the exponent m in the equation $p/p_{max} = \nu^m$ for all the powders being equal to five. The shrinkage of compacts during sintering for all the compaction pressures investigated begins at temperatures above 1200°C. The decisive factor in the manufacture of high-density sintered tungsten from powder F (a high-activity powder grade with a rough particle surface) in the case of compaction in the pressure range 9 to 100 kg/mm² is the sintering temperature; a density of ~90% can be attained. Increasing the compaction pressure results in increased density of sintered compacts to 94%. High-density (93 to 96%) sintered compacts from powder Sph (having smooth particles of spherical shape) can only be obtained by using high (more than 100 kg/mm²) isostatic pressures. (auth)

25156 PREPARATION AND SINTERING OF TUNGSTEN–RHENIUM ALLOY POWDERS. Ershova, I. O.; Dzneladze, Zh. I. pp 100-103 of Researches in Powder Metallurgy. Vol. 2. Borok, B. A. (Ed.). New York; Plenum Publishing Corp. (1972).

To study the sinterability of W–Re alloy powders as a function of their composition, experimental powder batches were prepared using fine- and coarse-grained WO_2 and potassium and ammonium perrhenates as starting materials. For this purpose use was made of compacts, 18 mm in diameter and 10 mm high, pressed in a steel die set under a pressure of 23,000 kg/mm². Sintering was carried out in the range 1000 to 2000°C at 200°C intervals for 3 h in a hydrogen stream with a dew point not exceeding –30°C. Results of the experiments show that the best results in the preparation of tungsten–rhenium alloy powders with 1 to 25% Re are obtained when mixtures of fine-grained tungsten dioxide and potassium or ammonium perrhenate are subjected to simultaneous hydrogen reduction for 3 to 4 h at 1400°C. (JRD)

25157 SINTERED Nb–Ti–Zr ALLOY. Kiyanskii, I. A.; Borok, B. A.; Dzneladze, Zh. I.; Zaikin, E. I.; Petrov, L. N. pp 108-112 of Researches in Powder Metallurgy. Vol. 2. Borok, B. A. (Ed.). New York; Plenum Publishing Corp. (1972).

Using the technique of simultaneous reduction of mixed oxides with calcium hydride, 65% Nb–25% Ti–10% Zr alloy powders of uniform composition were produced. Adding calcium chloride to a simultaneous reduction charge lowers the gas content of the resulting powder. Parts of high density and low gaseous impurity content are obtained when stepwise heating is employed in the low-temperature stage of sintering of blanks. The electron-beam method of heating shortens the sintering process and promotes production of good-quality material. (auth)

25158 HIGH-TEMPERATURE INDUCTION FURNACE FOR THE SINTERING OF REFRACTORY METALS IN A HYDROGEN ATMOSPHERE. Lobashev, B. P.; Kunitskii, V. N. pp 115-118 of Researches in Powder Metallurgy. Vol. 2. Borok, B. A. (Ed.). New York; Plenum Publishing Corp. (1972).

An induction furnace is described for sintering refractory metals which incorporates its induction coil as a part of the wall which acts as a gastight enclosure shell. The furnace wall is water cooled to protect it from the hot zone. Using this design, specimens can be heated in hydrogen atmosphere for long periods of time at 2000°C. (JRD)

25159 PROCESS FOR OBTAINING TANTALUM OR NIOBIUM METALLIC POWDER FROM SOLID BARS. Hermann, C.; Starck, B. Belgian Patent 725,002. 5 Dec 1968. Priority Date 29 Apr 1967, Federal Republic of Germany (F. R. Germany).

A procedure is described for obtaining metallic powder of tantalum or niobium or their alloys starting with solid fused or fritted bars. The procedure consists of rendering the surface-cleaned bars friable in hydrogen without previous fragmentation in such a way that they disintegrate into a coarse powder of metallic hydride. (tr-auth)

25160 GAS ANALYSIS IN AN rf SPUTTERING PLANT. Cox, R. E. L.; Holland, L. (Edwards High Vacuum Ltd., Crawley, Eng.). Nature (London) Phys. Sci.; 241: No. 112, 149-150(19 Feb 1973).

When thin films of active metals are prepared by ion impact sputtering in the presence of plasma discharges the deposits may be contaminated by gas impurities that react with condensing metal or form sputterable compounds on the target surface. It has been proposed that such gas sorption effects might be used for reducing the level of impurities in the gas atmosphere of the deposition zone, a technique termed "getter sputtering." Although this technique has shown its value in terms of improved film characteristics there appears to have been no published analysis of the gases in a typical system. Such information would test the relative effectiveness of this technique over conventional evacuation. Experimental work is described using the rf getter sputtering system described by Holland and Priestland (Vacuum 22: 133(1972)). The Ar gas composition was determined by an Edwards E.180 mass spectrometer, and Ta was chosen as target material because of its value as a film material and its chemical activity. The mass spectra obtained showed the effect of gettering on the composition of the residual gas atmosphere. The mass spectrum taken immediately after sputtering ceased and the gas supply was shut off showed that most of the gas components had greatly decreased partial pressures. Values are given for CO_2, O_2, N_2, CO, water vapor and hydrocarbons. After 15 min the activity of the sputtered film had decreased and the constitution of the residual atmosphere was similar to that before sputtering. These results show the value of gettering for producing films that would require the use of ultra-high-vacuum technology, with its protracted cycle times. (UK)

25161 INVESTIGATION OF PARTIALLY DISSOLVED SEPARATED SECOND PHASE IN AN ALLOY BASED ON MOLYBDENUM. Denisyuk, V. A.; Drachinskii, A. S.; Pisarenko, V. A.; Trefilov, V. I. (Inst. of Metal Physics, Kiev). Fiz. Metal. Metalloved.; 34: No. 5, 1117-1120(1972). (In Russian).

Separated second-phase studies were conducted with the alloy Mo–0.012% C–0.5% Ti–0.05% Zr, samples of which had been annealed in a vacuum at 2200°C for one hour and slowly cooled (regime I). Selected samples were electrically heated at the rate of 150 to 200°/sec, and cooled at either 4000°/sec (regime II) or 200°/sec (regime III). The extent to which a second phase had separated was ascertained by an electron microscope. Partially dissolved Zr carbide was observed after the treatment of regime II. (KSW)

25162 INTERNAL STRESSES AND RESISTIVITY OF LOW-VOLTAGE SPUTTERED TUNGSTEN FILMS. Sun, R. C.; Tisone, T. C.; Cruzan, P. D. (Bell Telephone Laboratories, Allentown, Pennsylvania 18103). J. Appl. Phys. 44: No. 3, 1009-1016 (Mar 1973).

The continuing development of microelectronic circuits toward greater

complexity has stimulated interest in new materials and processes compatible with the currently known silicon device technology. Tungsten has been considered as the first-level conductor for a multilevel structure due to its relatively low electrical resistivity, its thermal expansion coefficient which matches fairly well to that of silicon, its demonstrated good adherence to the dielectrics of interest, and its ability to withstand high-temperature processing. The present work is a part of a study of the dependence of the properties of low-voltage triode sputtered tungsten films upon deposition parameters. The effects on internal stress and resistivity of tungsten films are reported here. Tungsten films have been deposited with thicknesses from 1000 to 15 000 Å and with resistivities as low as 8 $\mu\Omega$ cm (1.55 of the bulk). These films were deposited at 1 u argon pressure at rates in the range of 50–400 Å/min. The electrical resistivity was observed to increase with increasing deposition rate, decreasing film thickness, and decreasing substrate temperature. The impurity concentration was found to be small by electron microprobe and ion probe techniques and, hence, did not completely account for the observed changes in resistivity. The internal stress was determined by two x-ray methods: (i) precision lattice parameter determination and (ii) a two-exposure technique. In general, depending upon the deposition conditions, tensile or compressive stresses of the order 10^9–10^{10} dyn/cm^2 were observed. The compressive stress was observed to increase with decreasing film thickness and increasing deposition rate. Increasing the substrate temperature caused the compressive stress to decrease to zero and become tensile. This changeover temperature was observed to be 650 °C for a 5000-Å film deposited at 115 Å/min. The observed results are discussed briefly in terms of microstructure changes. (auth)

25163 TUNGSTEN NEWS, JANUARY 1973. Tungsten News; 1-18(Jan 1973).

Research and development activities in W technology are reviewed. Information is included on W metal, WC, W-base alloys, properties of alloys containing additions of W, processing of W ores, and properties of W compounds other than carbides. (376 references) (JRD)

25164 PECULARITIES OF PULSED-LASER WELDING OF LAP JOINTS WITH A GAP. Velichko, O. A.; Garashchuk, V. P.; Moravskii, V. E. Avtomat. Svarka; No. 4, 75-76(Apr 1972). (In Russian).

The strengths of joints obtained using a pulsed laser were correlated with the gap between the welded plates for a number of steels and for Mo, Cu, Ti, Ni, Ta, W, and Al. The gap was increased up to 300 μm and the upper strip thickness and degree of melting were varied. (Metals Abstr.)

25165 EFFECT OF WELDING CONDITIONS ON THE OXYGEN DISTRIBUTION IN JOINTS IN NIOBIUM AND ITS ALLOYS. Smiyan, O. D.; Gurevich, S. M.; Nerodenko, M. M.; Asnis, E. A.; Kruzhkov, A. G. Avtomat. Svarka; No. 6, 13-15(Jun 1972). (In Russian).

The O content of joint metals was analyzed by mass spectrometry. Joints produced by Ar-arc and electron-beam welding were investigated, O concentration profiles being presented for each case. Pure Nb and an alloy with Zr and C additions were studied. (Metals Abstr.)

25166 PROCEDURE AND EQUIPMENT FOR FORMING A LEAKTIGHT JOINT BETWEEN TWO METAL PARTS. Jullien, L.; Collomb, J. (to Compagnie pour l'Etude et la Realisation de Combustibles Atomiques). French Patent 1,603,071. 23 Apr 1971. Filed date 28 Aug 1968. 9p. (In French).

A procedure for manufacturing an apparatus utilizing an Al block plugged with a stainless steel part is described. The leaktight joint between the two parts is ensured by an intermediate diffused layer. The procedure consists of bringing the two parts to a predetermined temperature of 650°C (less than the liquidus points of the stainless steel and the Al) at which the stainless steel part is harder than the Al block. A force oriented in the direction along which the stainless steel part is flattened is used to plug this part into the block. The apparatus can be used to house measuring instruments and can pass through a wall behind which dangerous reactions (e.g., nuclear reactions) are taking place. An application is given in the form of an instrument head for a thermocouple fixed to an Al nuclear cartridge. This head consists of an Al plug with a stainless steel support. (France).

25167 TEMPERATURE IN THE ROLL-METAL CONTACT ZONE DURING HOT ROLLING OF MOLYBDENUM. Gurevich, Ya. B. Tsvetn. Metal.; No. 11, 58-61(Nov 1972). (In Russian).

Calculations were made of the effect of rolling Mo in the absence of oxide and in the presence of oxide layers 0.05-, 0.1-, and 0.5-mm thick on rollers fabricated from steel, cast iron, and hard alloy. Repeated heating and rolling at 600 to 1000°C did not affect the quality of the material and led to a drop in its hardness. (tr-auth)

25168 INTERACTION OF MOLTEN STEEL WITH SOLID NIOBIUM AND THE FORMATION OF THE INTERMETALLIC LAYERS. Sivov, E. N.; Kartashkin, B. A. (Moscow Inst. of Aviation Tech.). Svar. Proizv.; No. 1, 6-8(Jan 1973). (In Russian).

Tests were conducted into the reaction processes occurring when steel and niobium are welded. Welding was done using an electron-beam unit at a vacuum of 5×10^{-5} mm Hg with the beam focused on the niobium base (VN-2AE niobium alloy), 0.5 mm thick, and a weighed portion of Kh18N10T steel (approximately 0.4 g). It was established that the basic processes involved in welding steel with niobium is the wetting of the niobium with the molten steel and the dissolving and subsequent diffusion of niobium into the steel. Temperature and length of contact of the molten metal with the solid metal are the determining factors of these processes. It was shown that the formation of intermetallic layers leads to a significant lowering of the mechanical properties of niobium+steel joints. For a layer thickness of 2 to 3 μ the weld joint strength is reduced from 55 to 37 kgf/mm^2. The established principles make it possible to evaluate the probability of intermetallic layer formation both during welding and during performance of the weld seam at high temperatures. A method of calculating intermetallic layer thickness has been developed in relation to the process temperature and time of solid and liquid phase contact. (JPRS)

25169 RELATIONS BETWEEN WELDING METHOD, TECHNOLOGY, AND CORROSION BEHAVIOR OF A WELDING ZIRCONIUM–NIOBIUM ALLOY. Beckert, M.; Marquardt, E. Schweisstechnik (Berlin); 22: No. 1, 11-14(Jan 1972). (In German).

The optimum conditions and techniques for TIG and electron-beam welding of Zr–Nb 2.5 alloy are given. Corrosion behavior at high temperature and in water is analyzed in relation to changes occurring during welding. The effect of weld structure on joint properties when specified techniques are followed is discussed. (32 references) (Metals Abstr.)

25170 X-RAY SPECTRAL ANALYSIS OF SOLDERED NIOBIUM JOINTS. Grishin, V. L.; Trusov, Yu. A. Svar. Proizv.; No. 3, 14-15(Mar 1972). (In Russian).

Niobium sheets of thickness 0.5 to 1.5 mm were soldered using a Ti-base solder at ~1650°C for a 5-min period. X-ray analysis of sections through the joints was used to deduce diffusion coefficient for the metals of the solder into Nb. (Metals Abstr.)

25171 OPTIMIZATION OF THE PROCESSES OF OBTAINING SPHERICAL ZIRCONIUM POWDER BY PLASMA ATOMIZATION OF WIRE USING MATHEMATICAL STATISTICS. Kozlov, A. N.; Dubinin, G. N.; Aleksandrova, I. F.; Kravetskii, G. A.; Ruzinov, L. P.; Slobodchikova, R. I. Tr., Mosk. Aviats. Inst., Sb. Statei; No. 228, 130-138(1971). (In Russian).

The optimal conditions of plasma atomization of Zr wire to obtain spherical powder with a particle size of 400 to 800 μ sufficiently pure with respect to N_2 and O_2 (with a granule microhardness ≤300 to 500 kg/mm^2) are defined. When processing the experimental data, the ranging method was used. A vacuum plasma atomization device was designed and manufactured for obtaining spherical powders of chemically active refractory metals. The optimal conditions of the Zr atomization process are as follows: current 500 ± 60 amps, argon flow rate 3.2 m^3/hr, rarefaction in the chamber 400 mm Hg, spacing between the wire and the nozzle section 0.5 mm. The yield of the Zr powder fraction 400 to 800 μ in size is 60%. (JPRS)

25172 HYDROSTATIC EXTRUSION DRAWING OF BERYLLIUM WIRE. I. Uy, J. C.; Richardson, B. D.; Felker, T. S.; Fiorentino, F. J. Wire Ind.; 39: No. 457, 40-43(Jan 1972).

Production speeds ≃2000 ft/min, and a reduction in area of 60%/pass are reported for Be wire. These figures represent significant improvements on the 150 ft/min and 12.5%/pass used commercially. The main objective was to establish the tooling and process for prototype production of 0.005-in. dia from 0.018-in. dia Be wire by hydrostatic extrusion drawing. Cast ingots were hot extruded at 1800°F in a steel jacket to 0.375-in. rod. Rods were then drawn to 0.020-in. in Ni sheaths at 700 to 800°F. The Ni sheaths were chemically removed, and the wire annealed in air at 1300°F for 30 min. Lubricants and fluids are discussed. (Metals Abstr.)

25173 NEW DEVELOPMENTS IN POWDER METALLURGY. Thuemmler, F. (Kernforschungszentrum, Karlsruhe, Ger.). Z. Werkstofftech.; 3: No. 8, 394-414(1972). (In German).

New developments in powder metallurgy are discussed, with special emphasis on technological aspects. Papers from the most important meetings held during the last years are noted, along with other literature. The basic technologies and the ma-

terials themselves are discussed. The limits to the field of ceramics are fixed by involving metallic hard compounds (carbides), but leaving out nonmetallic materials. Also, compound materials with metallic components are considered. In the paragraph on basic investigations approaches with importance for further technological development are discussed. The competition with other technological processes, opening of new groups of materials for powder metallurgy, new technological processes, new fields of application, successes and sometimes failures appear very dynamic in this field. (182 references) (GF)

25174 HYDROSTATIC EXTRUSION DRAWING OF BERYLLIUM WIRE. II. Uy, J. C.; Richardson, B. D.; Felker, T. S.; Fiorentino, F. J. Wire Ind.; 39: No. 458, 110-112(Feb 1972).

The Hydraw process applied to Cu-coated Be wire allows reductions from 0.018 to 0.005 in. dia in three passes at temperatures of ~300°F to be achieved. Reductions >60%/pass and speeds >2000 ft/min compare favorably with the 12.5%/pass and 150 ft/min used commercially. The properties of the product are good though slightly poorer than the present commercial results. The process variables and engineering details of the new process are delineated, and brief reference is made to the economics of hydrostatic extrusion. (Metals Abstr.)

25175 DEVELOPMENT, PROCESSING, AND USE OF NITROGEN-ALLOYED HIGH MOLYBDENUM STEEL X3 CrNiMoN 17 13 5. Baeumel, A. (Boehler Gebr. und Co. AG, Duesseldorf, Ger.); Horn, E. M.; Siebers, G. Werkst. Korros.; 23: No. 11, 973-983(1972). (In German).

Addition of 0.15% N to the steel X5-CrNiMo 17 13 delays the precipitation of intermetallic phases and chromium carbides. The nitrogen containing steel can be welded up to a plate thickness of 30 mm without precipitation; hot cracking has not been observed either. The weld metal corresponds to the base material with respect to ductility and corrosion resistance. It is resistant to pitting, crevice corrosion, and stress-corrosion cracking; in particular, in mixed acids. Applications include textile industry (bleaching equipment and heating equipment), shipbuilding (driving shafts, exhaust gas coolers, and waste gas condenser tubing), water desalination equipment, nuclear industry (evaporator) for radioactive waste water and processing of radioactive waste in fluoride containing nitric acid), and chemical industry (pressure container material and heat exchangers for brackish water). (27 figures, 8 references) (GF)

Properties, Structure, and Phase Studies

Refer also to abstracts 24812, 25117, 26011, 26667, 26680, 26696, and 26740.

25176 (AD-474551) RESEARCH FOR SOLUBILITY OF INTERSTITIALS IN NIOBIUM. II. A Study of Niobium-rich Alloys in the Ternary Systems Nb-Hf-O, Nb-Hf-N, and Nb-Hf-C. Summary Technical Report, 15 April 1963-1 June 1964. Taylor, A. (Westinghouse Research Labs., Pittsburgh, PA). Oct 1965. Contract AF33(657)-11157. 136p. (AFML-TR-65-48(Pt.2)). NTIS.

The solubility of oxygen, nitrogen, and carbon in niobium-rich niobium--hafnium alloys was studied by means of x-ray-diffraction, micrographic, and thermal techniques, using both a dynamic leak method and a Sieverts apparatus. (NTIS)

25177 (AD-748270) RESEARCH ON RARE EARTH-COBALT ALLOYS AND COMPOUNDS. Technical Report, 15 October 1970-1 November 1971. Schweizer, J. (Dayton Univ., Ohio. Research Inst.). Apr 1972. Contract F33615-70-C-1625. 66p. (UDRI-TR-72-27; AFML-TR-72-82). NTIS.

The report contains a collection of six papers dealing with some magnetic properties of rare earth-cobalt alloys and the crystalline and magnetic structures of some rare earth-cobalt intermetallic phases. (NTIS)

25178 (AD-864287) EFFECTS OF THERMAL-MECHANICAL VARIABLES ON CREEP PROPERTIES OF HIGH-STRENGTH NIOBIUM ALLOYS. Final Report, 1 April 1967-30 January 1969. Cornie, J. A.; Begley, R. T. (Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.). Aug 1969. Contract F33615-67-C-1443. 196p. (AFML-TR-69-224). NTIS.

A comparison of the properties of two high-strength niobium base alloys, Nb-1 (Nb-30W-1Zr-0.06C-0.04N) and B-88 (Nb-28W-2Hf-0.067C) was made to reconcile the reported variation in mechanical properties of the two compositions. Studies of recrystallization, grain growth, and response to thermal-mechanical processing were carried out to characterize the material. (auth)

25179 (AD-865426) PLANE-STRAIN FRACTURE-TOUGHNESS DATA FOR SELECTED METALS AND ALLOYS. Campbell, J. E. (Battelle Memorial Inst., Columbus, Ohio. Defense Metals Information Center). Jun 1969. Contract F33615-69-C-1343. 33p. (DMIC-S-28). NTIS.

The report contains the first compilation of available plane-strain fracture toughness data and is the result of considerable interest during the past few years in developing test methods for obtaining these data. The report is divided into sections on aluminum alloys, high-strength alloy steels, intermediate- and low-strength steels, precipitation-hardening stainless steels, titanium alloys, nickel-base Alloy 718, and beryllium. (NTIS)

25180 (AD-868334) EFFECTS OF HIGH PRESSURE ON DEFORMATION CHARACTERISTICS. I. Mechanical Behavior of Beryllium at High Pressure. II. Measurement of Redundant Work with Hydrostatic Extrusion. Final Report, 7 March 1966-6 Mar 1968. Radcliffe, S. V.; Aladag, E.; Wallace, J. F.; Das, G. (Case Western Reserve Univ., Cleveland, Ohio. Div. of Metallurgy and Materials Science). Apr 1970. Contract AF33(615)-3750. 51p. (AFML-TR-69-17). NTIS.

A study was conducted with the principal objectives of elucidating the mechanical behavior of well-characterized polycrystalline beryllium as a function of pressure at room temperature, in order to facilitate understanding of the factors controlling plastic flow and fracture under ambient conditions and to assist in optimizing the application of forming processes to this metal at high pressure, e.g., hydrostatic extrusion. (NTIS)

25181 (AD-884041) EFFECT OF STRAIN RATE, TEMPERATURE, AND MULTIAXIAL STRESS ON STRENGTH AND DUCTILITY OF S-200E BERYLLIUM AND 6Al-4V TITANIUM. Final Report, December 1968-September 1970. Lindholm, U. S.; Yeakley, L. M. (Southwest Research Inst., San Antonio, Tex. Dept. of Mechanical Sciences). Mar 1971. Contract F33615-69-C-1248. 98p. (AFML-TR-71-37). NTIS.

The strength properties of S-200E beryllium and 6Al-4V titanium were determined under conditions of combined stress, elevated temperatures, and high strain rates. Beryllium specimens were obtained from both extruded rod and hot-pressed block. The range of test conditions included strain rates from 0.001 to 1000/sec, temperatures from 70 to 1000°F, and both uniaxial and biaxial states of stress. The biaxial stress states were obtained with thin-walled tubular specimens loaded with axial tension or compression, torsion, or internal pressure. (NTIS)

25182 (ANL-8001) REVIEW OF THE CHEMICAL, PHYSICAL, AND THERMAL PROPERTIES OF LITHIUM THAT ARE RELATED TO ITS USE IN FUSION REACTORS. Maroni, V. A.; Cairns, E. J.; Cafasso, F. A. (Argonne National Lab., ILL). Mar 1973. Contract W-31-109-eng-38. 52p. Dep. NTIS $5.45.

Among the topics covered are natural abundance; thermodynamic and transport properties; characterization, analysis, and control of species in lithium; and corrosion of materials (including electronic insulators) by molten lithium. Throughout this review an attempt was made to indicate the importance of the individual properties as they would affect the overall design considerations of an operating reactor and to point out areas where information is lacking and where additional work is needed. (auth)

25183 (HSSTP-TR-27) CRACK ARREST IN AN INCREASING K FIELD. Crosley, P. B.; Ripling, E. J. (Materials Research Lab., Inc., Glenwood, Ill.). Jan 1973. Subcontract 3152. 22p. Dep. NTIS $3.25.

For Oak Ridge National Lab., TN.

Six tests of single edge notch (SEN) A533 B steel specimens were carried out at room temperature. One specimen did not crack on hydrogen charging. For the other specimens, cracking occurred within the first few minutes' charging time. In three of these specimens the crack was arrested by the base plate, while in the other two, the crack propagated completely through the specimen. It was found that crack-arrest toughness, (K_{Ia}), as measured in an increasing K field, is essentially identical with K_{Ia} measured with a contoured double cantilever beam (DCB) specimen having a zero-K gradient. (JRD)

25184 (IS-M-5) PHYSICAL METALLURGY AND ALLOY THEORY OF RARE EARTH ALLOYS AND INTERMETALLIC COMPOUNDS. Gschneidner, K. A. Jr. (Iowa State Univ. of Science and Technology, Ames). 1971. 5p. (CONF-710712-4). Dep. NTIS $3.00.

From conference on rare earths and actinides; Durham, UK (5 Jul 1971).

Aspects of the crystal chemistry of lanthanide intermetallic compounds are discussed. The physical properties of lanthanides are reviewed, and a model of the valence configuration involving

4f electrons is described. Information is included on crystal chemistry, physical properties, and metallic bonding. (JRD)

25185 (JUL-875-RX) CRYSTAL FILTER FOR COLD AND THERMAL NEUTRON BEAMS. (A COLLECTION OF DATA). Scharenberg, W. (Kernforschungsanlage, Juelich (West Germany). Zentralinstitut fuer Reaktorexperimente). Aug 1972. 54p. (In German). Dep. NTIS (U. S. Sales Only).

Polycrystalline and single-crystal neutron filters have proved useful tools for improving the quality of cold and thermal reactor neutron beams for elastic and inelastic scattering work. The nuclear, chemical, and physical properties of crystals that are appropriate for filter materials are discussed. Theoretical and experimental neutron transmissions are compared, and the most pertinent data are compiled for the commonly used filter materials including bismuth, lead, beryllium, beryllium oxide, quartz, magnesium oxide and pyrolytic graphite. A few experimental facilities are also shown. (47 references) (auth)

25186 (UCRL-51182) DIFFUSIVITY AND SOLUBILITY OF NITROGEN IN MOLYBDENUM AND THE TRAPPING OF NITROGEN BY CARBON IN MOLYBDENUM. Weaver, D. E. (California Univ., Livermore. Lawrence Livermore Lab.). 25 Oct 1972. Contract W-7405-Eng-48. 85p. Dep. NTIS $6.25.

By employing ultrahigh-vacuum techniques, the outgassing kinetics of nitrogen-saturated molybdenum were determined over a wide range of temperatures (1050 to 1925°C) and saturation pressures (0 to 760 torr) using both single and polycrystalline samples containing various amounts of carbon (<2 to 430 wt ppM). It was found that the degassing rate is strictly diffusion-controlled under all conditions studied, thus allowing the diffusivity and the solubility of N in Mo to be calculated from the kinetic data. For high-purity, zone-refined single crystals, as well as decarburized polycrystalline Mo containing <3 ppM C, the temperature dependence of the diffusivity of N is well represented by $D = (2.98 \pm 0.4) \times 10^{-3} \times \exp[(-24{,}500 \pm 230)/RT] cm^2/sec$ and the solubility of N in Mo by $S = (3.6 \pm 0.7) \times 10^4 P^{½} \times \exp[(-19{,}000 \pm 520)/RT]$ at. ppM/atm^{½}, P being the N pressure in atmospheres. Pronounced trapping effects were observed when C is present in amounts exceeding the solubility limit. Trapping is manifest by: (1) anomalously low values of the diffusion coefficient, together with a significantly higher activation energy for N diffusion; and (2) high apparent values of the solubility. When C is all in solution instead of in second-phase precipitates, both the diffusivity and solubility of N are the same as for C-free samples. A model has been developed which explains the trapping effects caused by the second-phase carbide precipitates. This model assumes that the diffusing N is trapped by the bulk of the carbides, and that the N can diffuse in the carbide. (121 references) (auth)

25187 POTENTIAL OF METALLIC THORIUM FOR LWR's. Zorzoli, G. B. (CISE, Milan). Energ. Nucl. (Milan); 20: No. 2, 97-101(Feb 1973).

The use of thorium metal as a LWR fuel is examined on the basis of assumptions more consistent than those adopted in a previous paper. On the same basis, metallic thorium is compared with thorium oxide as a fuel for a LWBR. In both cases the use of metallic thorium looks very promising as far as energy cost and savings of natural resources are concerned. (auth)

25188 FEATURES OF THE STRAIN HARDENING OF MOLYBDENUM SINGLE CRYSTALS AT LOW TEMPERATURES. Mochalov, G. A.; Evstyukhin, A. I.; Emel'yanov, V. S. Met. Metalloved. Chist. Metal., Sb. Nauch. Rabot; No. 9, 85-93(1971). (In Russian).

An analysis is reported of the factors responsible for the strain hardening of Mo single crystals at low temperature. For pure Mo single-crystals, and for single crystals of other refractory metals with a bcc lattice, there is definite anisotropy of the PS, YS, and critical shear stress with the orientation and sign of the applied stress (tensile or compressive). These properties are markedly dependent on tests temperature below 0.2 T_M(T_M is the m.p.) for all orientations of the crystal axis. At the same time for other orientations, e.g. [110] and [100], the PS/temperature dependence has a different character. (31 references). (Metals Abstr.)

25189 METHODS FOR STUDYING SINTERED MATERIALS. Zdenek, K. Pokroky Praskove Met. VUPM; No. 1, 63-82(1971). (In Czech).

An electron microprobe equipment is described, as are the different methods of analysis that are possible with it. Analyses of specimens of WC, Ni–Cr–B–Si alloy, Ni–Al alloy, and an Au-plated contact are discussed and illustrated. (Metals Abstr.)

25190 RESULTS AND PROSPECTS FOR STUDYING THE PHASE DIAGRAMS OF SYSTEMS WITH URANIUM. Ivanov, O. S. pp 5–13 of Diagrammy Sostoyaniya Metal. Sistem. Moscow; Izdatel'stvo Nauka (1971). (In Russian).

Regularities in the structure of phase diagrams of binary systems of U with s-, p-, d-, and f-elements are examined. The need for further study of many such diagrams, e.g., U–Be, U–C, U–N, U–O, and U–Th is stressed. Similarly, there are not many detailed studies of ternary and more complex systems involving U. A short description is given of characteristic features of the diagrams of important ternary and more complex systems including U–Zr–Nb, U–Zr–Mo, U–Zr–Nb–Mo, and U–UAl_2–UFe_2–UMn_2. (Metals Abstr.)

25191 THORIUM PHASE DIAGRAMS: A REVIEW. Badaeva, T. A. pp 13-19 of Diagrammy Sostoyaniya Metal. Sistem. Moscow; Izdatel'stvo Nauka (1971). (In Russian).

The general laws pertaining to the structure of phase diagrams of binary systems with Th are reviewed and features connected with the dual chemical nature of Th discussed. Characteristic signs of some diagrams of Th ternary systems are pointed out; these are associated with the formation of wide solid-solution regions based on bcc lattices at high temperature: and with a region of layering into two solid solutions at lower temperature. The metastable phases that form during quenching from the region of β solid solution are analyzed. (Metals Abstr.)

25192 PHASE DIAGRAMS WHICH INCLUDE URANIUM AND CARBON. Alekseeva, Z. M.; Ivanov, O. S. pp 20-26 of Diagrammy Sostoyaniya Metal. Sistem. Moscow; Izdatel'stvo Nauka (1971). (In Russian).

Results from a study of >20 ternary phase diagrams of U, C, and another metal are discussed and generalized. The original results for the U–W–C and U–Mo–C systems are used to suggest the nature of the monoclinic phases found in systems close to $UMeC_2$ composition. Lattice constants are given for a new compound in the U–W–C system related to the tetragonal system (a = 8.33, c = 3.14 Å) (24 references). (Metals Abstr.)

25193 ALGEBRAIC DESCRIPTION OF SOLIDUS AND LIQUIDUS OF FOUR-COMPONENT GAMMA SOLID SOLUTIONS OF URANIUM–ZIRCONIUM–NIOBIUM–MOLYBDENUM. Kuznetsova, R. I.; Badaeva, T. A.; Ivanov, O. S. pp 27-30 of Diagrammy Sostoyaniya Metal. Sistem. Moscow; Izdatel'stvo Nauka (1971). (In Russian).

Experimental determinations of the solidus and liquidus temperature of 48 alloys of the U–Zr–Nb–Mo system containing ≤30 at.% of each of the elements were used to derive an equation of the second and third power for describing the solidus and liquidus. The advantages of the algebraic over the geometric method of representing multicomponent phase diagrams are discussed. (Metals Abstr.)

25194 BINARY PHASE DIAGRAMS OF ZIRCONIUM. Tararaeva, E. M.; Ivanov, O. S. pp 31-38 of Diagrammy Sostoyaniya Metal. Sistem. Moscow; Izdatel'stvo Nauka (1971). (In Russian).

Data on Zr binary phase diagrams are reviewed and systematized. About 40 binary phase diagrams were prepared and further information given on the reaction of Zr with 17 different elements. The diagrams that received most study are those for Zr with d-elements. (Metals Abstr.)

25195 ZIRCONIUM ALLOYS: PHASE DIAGRAMS OF TERNARY AND MORE COMPLEX SYSTEMS. Adamova, A. S.; Ivanov, O. S. pp 38-54 of Diagrammy Sostoyaniya Metal. Sistem. Moscow; Izdatel'stvo Nauka (1971). (In Russian).

A review of ternary and more complex phase diagrams involving Zr is presented. To date 96 Zr ternary systems are known although not all to the same extent. Only 11 have been studied in detail over the whole concentration range, and 4 quaternary Zr systems are given in the literature. A short account of work on the Zr–Nb–Cr–Mo system is included. (Metals Abstr.)

25196 PHASE DIAGRAM OF THE NIOBIUM–TITANIUM–ZIRCONIUM–HAFNIUM SYSTEM. Raevskii, I. I.; Stepanov, N. V.; Skryabina, M. A.; Ivanov, O. S. pp 54-61 of Diagrammy Sostoyaniya Metal. Sistem. Moscow; Izdatel'stvo Nauka (1971). (In Russian).

The x-ray method was used to study strongly deformed alloys along three sections with constant Nb contents of 70, 50, and 30 at.% and to construct the Nb–Ti–Zr–Hf phase diagram. There is unlimited mutual solubility of the components below the solidus surface. Two phases, β and ($\alpha + \beta$), exist between 975 and 1750°C, and below 975°C there is a second two-phase region ($\beta_{Nb} + \beta_{Zr}$), which at 700 to 750°C forms a three-phase ($\alpha + \beta_{Zr} + \beta_{Nb}$) region with the ($\alpha + \beta$). (Metals Abstr.)

25197 PHASE EQUILIBRIA OF THE NIOBIUM–ALUMINUM–GERMANIUM SYSTEM. Latysheva, V. I.; Pan, V. M.; Svechnikov, V. N.; Shishkin, E. A. 61-67 of Diagrammy Sostoyaniya Metal. Sistem. Moscow; Izdatel'stvo Nauka (1971). (In Russian)

A phase diagram was constructed for the Nb–Al–Ge system for Al and Ge contents up to 35 at.% and shown in the form of isothermal sections at 1000 to 2000°C, polythermal sections for various combinations of the components, and the liquidus surface. The existence of two 4-phase peritectic equilibria is proposed, i.e., at 1910°C, liquid $+\beta \rightleftharpoons \alpha + \sigma$ and at 1930°C, liquid $+\gamma \rightleftharpoons \beta + \sigma$. There was an appreciable solubility of Ge in the σ phase and the formation temperature of the σ phase was increased by Ge. A continuous series of solid solutions was found between the two isomorphic compounds βNb_3Al and βNb_3Ge in the solid state. (Metals Abstr.)

25198 PHASE EQUILIBRIA IN NIOBIUM–OXYGEN–HAFNIUM AND NIOBIUM–OXYGEN–ZIRCONIUM ALLOYS. Shurin, A. K.; Loktionov, V. A. pp 82-87 of Diagrammy Sostoyaniya Metal. Sistem. Moscow; Izdatel'stvo Nauka (1971). (In Russian).

From a study of the phase condition of Nb–Hf alloys a new variation of the phase diagram is proposed which confirms the presence of a monotectoid equilibrium. Isothermal sections were made of the Nb–Hf–O system at 1600 and 1000°C in the Nb–NbO–HfO_2–Hf region, Hf sharply lowering the solubility of O in Nb. Similar data were obtained with Zr in place of Hf; Zr sharply lowers the solubility of O in Nb to values of ~0.02–0.025 at.%. (Metals Abstr.)

25199 TERNARY PHASE DIAGRAMS OF TUNGSTEN WITH VARIOUS METALS. Povarova, K. B.; Savitskii, E. M. pp 87-95 of Diagrammy Sostoyaniya Metal. Sistem. Moscow; Izdatel'stvo Nauka (1971). (In Russian).

Literature data on ternary and multi-component systems of W with Groups IV–VIII elements with respect to phase diagrams are systematized. The best approaches for studying such systems are discussed. (Metals Abstr.)

25200 TUNGSTEN–MOLYBDENUM–NIOBIUM–TANTALUM QUATERNARY SYSTEM [PHASE DIAGRAM]. Pryakhina, L. I.; Polyakova, R. S.; Gromova, V. G.; Myasnikova, K. P.; Ozhimkova, O. V. pp 98-101 of Diagrammy Sostoyaniya Metal. Sistem. Moscow; Izdatel'stvo Nauka (1971). (In Russian).

The W–Mo–Nb–Ta system was studied for 4 sections with constant W contents of 90, 70, 50, and 30%. Diagrams were obtained for composition and hardness in the range 20 to 1100°C range and also a melting diagram by an optimum projection method. (Metals Abstr.)

25201 PHASE DIAGRAM OF THE TUNGSTEN–NIOBIUM–CARBON SYSTEM. Popova, N. M.; Fedorov, T. F.; Shamrai, F. I. pp 101-106 of Diagrammy Sostoyaniya Metal. Sistem. Moscow; Izdatel'stvo Nauka (1971). (In Russian).

X-ray and microstructural analyses and measurements of hardness and microhardness were used in a study of the W–Nb–C system. Isothermal sections were made at 2000°C. Isotherms for the combined solubility of C and Nb in W were obtained at 2000, 1700, and 1100°C in the solid condition. (11 references) (Metals Abstr.)

25202 HIGH-TEMPERATURE PHASE EQUILIBRIA IN THE MOLYBDENUM–TUNGSTEN–CARBON SYSTEM. Gorshkova, L. V.; Telegus, V. S.; Shamrai, F. I.; Kuz'ma, Yu. B. 106-108 of Diagrammy Sostoyaniya Metal. Sistem. Moscow; Izdatel'stvo Nauka (1971). (In Russian).

X-ray and microstructural analyses were used in a study of phase equilibria at 2000 and 2200°C in the Mo–W–C system up to 50 at. % C. There is a continuous series of solid solutions at these temperatures between the carbides Mo_2C and W_2C and the limiting solid solutions based on the carbides WC, α-MoC_{1-x}, and η-MoC_{1-x}. The solubility of C in the Mo–W solid solution falls with reduction in temperature. Small additions to Mo of W ~ 1.0 at. % markedly reduce the C solubility in Mo which then remains practically constant at 0.1 to 0.2 at. % (at 2000°C) with further increase in W content. (Metals Abstr.)

25203 MOLYBDENUM–TUNGSTEN–BORON PHASE DIAGRAM. Kharitonov, V. I.; Shamrai, F. I. pp 109-112 of Diagrammy Sostoyaniya Metal. Sistem. Moscow; Izdatel'stvo Nauka (1971). (In Russian).

Thermal, x-ray, and microstructural analyses and measurements of microhardness were used in a study of the Mo–W–B system, isothermal sections being made at 1100 and 1850°C. At these temperatures there is a continuous series of solid solutions of $(Mo, W)_2B$ and $(Mo, W)B_{12}$. The MoB–WB is quasi-binary and of the eutectic type; this eutectic crystallizes at WB 70 mol. % and melts at ~2500°C. At 1100°C, α-WB ~ 24 mol % dissolves in α-MoB, and α-MoB ~ 20 mol % in α-WB. The liquidus surface contours were constructed. (Metals Abstr.)

25204 MOLYBDENUM–NICKEL–ALUMINUM TERNARY SYSTEM. Pryakhina, L. I.; Myasnikova, K. P.; Markiv, V. Ya.; Burnasheva, V. V. pp 112-116 of Diagrammy Sostoyaniya Metal. Sistem. Moscow; Izdatel'stvo Nauka (1971). (In Russian).

X-ray, thermal, and microstructural analyses, and hardness measurements were used to study phase equilibria at 600°C in the Mo–Ni–Al system and to construct polythermal Ni_3Al–Mo and NiAl–Mo sections. Two ternary compounds form in the Al-rich region: Mo_8NiAl_{14} which has a $TiAl_3$ type structure, and $MoNi_4Al_{15}$. The NiAl–Mo section is quasi-binary with a crystallization of the eutectic type. The polythermal Ni_3Al–Mo section shows the 4 phase equilibrium $\gamma + \beta \rightleftharpoons \gamma' + \alpha$ at 1265°C. For some sections determinations were made of the hardness with respect to alloy composition. (Metals Abstr.)

25205 MOLYBDENUM–SILICON PHASE DIAGRAM. Svechnikov, V. N.; Kocherzhinskii, Yu. A.; Yupko, L. M. pp 116-119 of Diagrammy Sostoyaniya Metal. Sistem. Moscow; Izdatel'stvo Nauka (1971). (In Russian).

The complete Mo–Si phase diagram was obtained. The compounds Mo_3Si, Mo_5Si_3, and two polymorphic modifications of $MoSi_2$ (phase transformation ~1900°C) were shown to exist. The system has one eutectoid, 2 peritectic, and 3 eutectic equilibria. (22 references) (Metals Abstr.)

25206 PHASE DIAGRAM OF THE MOLYBDENUM–HAFNIUM–SILICON SYSTEM. Shurin, A. K. pp 120-124 of Diagrammy Sostoyaniya Metal. Sistem. Moscow; Izdatel'stvo Nauka (1971). (In Russian).

Hf–Si and Mo–Hf–Si alloys were studied. A phase diagram for the former is proposed in which the silicides Hf_2Si, Hf_5Si_3, Hf_3Si_2, Hf_5Si_4, HfSi, and $HfSi_2$ are formed. Isothermal sections of the ternary system were made at 1250 and 1600°C. In these alloys a ternary compound of equiatomic composition is formed and also a ternary compound of variable composition with a crystal structure of the high temperature modification of Mo_2Hf. Diffusion paths in Hf–Mo_5Si_3 and Hf–$MoSi_2$ were studied. (16 references) (Metals Abstr.)

25207 UPPER BOUNDARY OF THE REGION OF HOMOGENEITY OF THE SOLID SOLUTIONS $(Mo,Hf)C_{1-x}$ OF THE MOLYBDENUM–HAFNIUM–CARBON SYSTEM. Eremenko, V. N.; Shabanova, S. V.; Velikanova, T. Ya. pp 124-128 of Diagrammy Sostoyaniya Metal. Sistem. Moscow; Izdatel'stvo Nauka (1971). (In Russian).

Studies were made of the Mo–Hf–C system with particular attention given to the solid solution homogeneity boundaries in the phase diagram. The high-temperature cubic modification of the higher carbide of Mo and Hf carbide forms a continuous series of solid solutions. At 1400°C the region of these solutions is limited by an 8 at. % Hf content. At low temperature Hf addition stabilizes the η-MoC_{1-x}. At 1400°C the homogeneity region of the η phase lies within the limits of 2 to 3 at. % Hf. The linear surface solidus δ + C monotonously increases from the Mo–C side (2565°C) to the Hf–C side (3150°C) of the Mo–Hf–C system. A phase diagram is given for the interaction of the carbides in the alloys in the form of a projection of their surface saturation by C. (Metals Abstr.)

25208 PHASE EQUILIBRIA AND SOME PROPERTIES OF NICKEL-RICH ALLOYS OF THE NICKEL–ALUMINUM–NIOBIUM–MOLYBDENUM SYSTEM. Mints, R. S.; Toropov, V. M. pp 161-164 of Diagrammy Sostoyaniya Metal. Sistem. Moscow; Izdatel'stvo Nauka (1971). (In Russian).

Physical-chemical analysis was used to study phase equilibria in the Ni corner of the Ni–Al–Nb–Mo system from sections with constant Mo of 2 and 5% and Nb of 5, 10, and 15%. Determinations were made (i) of the boundaries of the volumes of the quaternary Ni(γ)-based and $Ni_3Al(\theta')$-based solid solutions, (ii) of the concentration and temperature positions of the phase boundaries of the γ and γ' phase boundaries, (iii) of the dependence of electrical resistivity and hardness of the alloys on composition, and (iv) of the combined solubility of Nb and Mo in Ni (in the Ni–Nb–Mo system) at 900 and 1200°C. (Metals Abstr.)

25209 NATURE OF ALLOYS OF RARE-EARTH METALS WITH YTTRIUM. Markova, I. A.; Torchinova, R. S.; Terekhova, V. F.; Savitskii, E. M. pp 170-174 of Diagrammy Sostoyaniya Metal. Sistem. Moscow; Izdatel'stvo Nauka (1971). (In Russian).

The general physico-chemical properties of rare-earth metals are described and an analysis made of phase diagrams of these metals with Y. The contribution of 4f electrons to bonding in the formation of alloys between rare-earth metals analogous to Y and rare-earth metals of the Y subgroup, is discussed as well as the conditions for the formation of phases with a Sm structure. An assessment is made of the physical-chemical behavior of Sm in rare-earth metal alloys. (Metals Abstr.)

25210 PHASE DIAGRAMS OF THE NEODYMIUM–PLATINUM AND ERBIUM–PLATINUM SYSTEMS. Kolesnichenko, V. E.; Terekhova, V. F.; Savitskii, E. M. pp 174-176 of Diagrammy Sostoyaniya Metal. Sistem. Moscow; Izdatel'stvo Nauka (1971). (In Russian).

Studies were made of the Nd–Pt and Er–Pt systems. The former shows five compounds, i.e. Nd_5Pt_2, NdPt, Nd_xPt_y, $NdPt_2$, $NdPt_5$ and the latter seven compounds, i.e., Er_3Pt, Er_2Pt, ErPt, Er_xPt_y, $ErPt_2$, $ErPt_3$, and $ErPt_5$. Of these NdPt, $NdPt_2$, ErPt, and $ErPt_3$ form from the melt and the others by peritectic reactions. The mutual solubilities of Nd–Pt and of Er–Pt are negligible. Three peritectic equilibria exist in each system. Pt lowers the temperature of the Nd allotropic transformation from 862 to 850°C. (Metals Abstr.)

25211 CHROMIUM–PRASEODYMIUM ALLOYS [PHASE DIAGRAM]. Svechnikov, V. N.; Kobzenko, G. F.; Kashevskaya, O. N.; Ivanchenko, V. G.; Martynchuk, E. L. pp 180-183 of Diagrammy Sostoyaniya Metal. Sistem. Moscow; Izdatel'stvo Nauka (1971). (In Russian).

Differential thermal, microstructural, and x-ray analyses were used to study Cr–Pr alloys over the whole concentration range and a phase diagram was constructed. The known allotropic transformation in Pr at 790°C was confirmed and a further such transformation shown to exist at 875°C. Solubilities of Pr in Cr were determined at 1600, 1700, 1750, and 1780°C. At 1800°C a monotectic reaction takes place in these alloys; at 895°C the α-Cr + γ-Pr eutectic crystallizes with Pr 97 at. % at the eutectic point. (Metals Abstr.)

25212 PHASE DIAGRAMS FOR CALCIUM WITH RARE-EARTH METALS. Stroganova, V. F.; Terekhova, V. F.; Savitskii, E. M. pp 186-188 of Diagrammy Sostoyaniya Metal. Sistem. Moscow; Izdatel'stvo Nauka (1971). (In Russian).

The interactions of Ca with rare-earth metals were studied and phase diagrams obtained for the Ca–Y, Ca–Nd, and Ca–Eu systems. The first two of these systems show limited solubility of the components in the solid state and a wide range of immiscibility in the liquid state. The Ca–Eu system has a continuous series of solid solutions between the high temperature β modification of Ca and Eu and a two-phase $\alpha + \beta$ region between the low temperature α modification of Ca and Eu. (Metals Abstr.)

25213 PHASE DIAGRAMS OF THE TERNARY SYSTEMS YTTRIUM–CHROMIUM–SILICON AND YTTRIUM–NICKEL–SILICON. Bodak, O. I.; Sobolev, A. S.; Gladyshevskii, E. I. pp 189-190 of Diagrammy Sostoyaniya Metal. Sistem. Moscow; Izdatel'stvo Nauka (1971). (In Russian).

Y–Cr–Si system over the whole concentration range and of the Y–Ni–Si system for the region Y 0 to 40 and Si 33 to 100 at. %. The following compounds were shown to exist: YCr_2Si_2, $YNiSi_4$, $YNiSi_2$, YNi_1Si_6, YNi_2Si_2, YNiSi, and $Y_3Ni_6Si_2$. The solubilities of Cr and Ni in YSi_{2-n} (of AlB_2 structure type) are ~8 and 26 at. %, respectively. In terms of ternary compound compositions and structures the Y–Ni–Si system is related to the Ce–Ni–Si system. (Metals Abstr.)

25214 INTERACTION OF RUTHENIUM WITH NIOBIUM AND ZIRCONIUM. Tatarkina, A. L.; Gryzunov, V. I.; Ronami, G. N.; Sokolovskaya, E. M.; Raevskaya, M. V. pp 196-200 of Diagrammy Sostoyaniya Metal. Sistem. Moscow; Izdatel'stvo Nauka (1971). (In Russian).

Physical-chemical methods were used in a study of the Zr–Nb–Ru system and of the nature of the phase equilibria in the ternary alloys at 1600 and 1050°C. Diffusion layer and x-ray microprobe analysis methods were used to study the binary systems Nb–Ru, Zn–Ru, and Zr–Nb. (Metals Abstr.)

25215 PHASE DIAGRAMS OF PALLADIUM AND PLATINUM WITH BARIUM, SCANDIUM, AND ZIRCONIUM. Savitskii, E. M.; Polyakova, V. P.; Krivdin, B. P.; Kozlov, A. A.; Khorlin, E. M. pp 200-203 of Diagrammy Sostoyaniya Metal. Sistem. Moscow; Izdatel'stvo Nauka (1971). (In Russian).

Physical-chemical analytical methods were used to study the interactions of Pt and Pd with Ba, Sc, and Zr. Phase diagrams were constructed for Pt–Ba and Pd–Ba (up to Ba 33 at. %) Pd–Sc, and Pd–Zr(50 at. %). The interaction of Pt and Pd with Groups II–IV elements has complex features that are associated with the formation of a series of intermetallic compounds including those of the types AB_5, AB_3, AB_2, and AB, where B is a Pt group element. (Metals Abstr.)

25216 HOMOGENEITY RANGE AND DEFECT STRUCTURE OF THE LAVES PHASE $NbFe_2$. Smith, A. W.; Rogers, J. A.; Rawlings, R. D. (Imperial Coll. of Science and Tech., London). Phys. Status Solidi (a); 15: No. 2, K119-K122(16 Feb 1973).

The variation of the lattice parameters a_0 and c_0 of $NbFe_2$ with composition was studied across the phase field. The phase boundaries were found to be located at 63 and 69 at. % Fe, and a_0, c_0 for the Fe-rich boundary were 4.823 and 7.869 Å and for the Nb-rich boundary 4.865 and 7.923 Å, respectively. The substitution of Nb for Fe and Fe for Nb on either side of stoichiometry is discussed using Vegard's law. A jump was observed between 66.3, and 67.1 at. %. (DLC)

25217 DETERMINATION OF THE CLOSED POROSITY OF SINTERED POROUS BODIES. Goryaev, G. A. pp 122-123 of Researches in Powder Metallurgy. Vol. 2. Borok, B. A. (Ed.). New York; Plenum Publishing Corp. (1972).

A new method is proposed for determining open and closed porosities, in which the test specimen is impregnated twice under different pressures of the gaseous atmosphere, the degree of impregnation is measured for each of the two pressures, and the values obtained are linearly extrapolated to zero pressure. The calculated degree of impregnation under zero pressure corresponds to the open porosity of the specimen, while the difference between the total and the open porosity gives the closed porosity. Experiments confirmed that the degree of impregnation of a porous specimen is linearly related to the pressure of the gaseous atmosphere in which impregnation is carried out. (auth)

25218 MECHANICAL BEHAVIOR OF MOLYBDENUM AND TANTALUM UNDER HIGH PRESSURES AT ELEVATED TEMPERATURES. Nishihara, M. (Kobe Steel Ltd., Japan); Miura, S.; Hirano, T. High Temp.–High Pressures; 4: No. 3, 281-291(1972).

In order to investigate the effects of hydrostatic pressure and temperature on the mechanical behavior of bcc refractory metals, tensile tests of commercially pure tantalum and molybdenum polycrystals were carried out under hydrostatic pressures of up to 5000 kgf cm^{-2} at temperatures up to 600°C. The tensile strength of the materials tested does not depend on hydrostatic pressure, while the yield stress decreases with increasing of pressure. Because of the presence of interstitial impurities, such as oxygen and nitrogen, the Portevin–Le Chatelier effect, which is caused by the interaction of solute atoms with moving dislocations, was observed, and the effects of hydrostatic pressure and temperature on this phenomenon have also been investigated. (auth)

25219 STUDY OF THE α' AND α'' MARTENSITES OF TITANIUM–NIOBIUM ALLOYS. Morniroli, J. P.; Gantois, M. (Ecole Nationale Superieure, Nancy). Compt. Rend., Ser. C; 275: No. 16, 869-871(16 Oct 1972). (In French).

Titanium alloys containing between 5 and 43% by weight of Nb were prepared. They were subsequently subjected to heating and cooling treatments (quenching, fast or slow cooling). Alloys containing less than 20% Nb possess for all cooling rates a structure consisting of an α' martensitic phase and a residual β phase. The parameters of the α' hexagonal martensitic phase are: a = 2.97 ± 0.01 and c = 4.70 ± 0.01 A. A new structure having an α'' orthorhombic phase and a residual β phase is obtained with alloys containing 20% or more of Nb by weight. The orientation relations found between the α' and α'' martensites and the β matrix demonstrate that the martensitic transformation mechanism proposed by Burgers is applicable to both the α' and the α'' phases. (auth)

25220 CALORIMETRIC MEASUREMENTS OF THE HEAT OF DISSOLUTION OF Dy AND Eu IN Sn. Bacha, A.; Chatillon-Colinet, C.; Percheron, A.; Mathieu, J. C. (Ecole Nationale Superieure d'Electrochimie et d'Electrometallurgie, Grenoble, France). Compt. Rend., Ser. C; 275: No. 17, 921-923(23 Oct 1972). (In French).

The heats of dissolution of Dy and Er in Sn were measured at 957 and 963°K. The limiting values of the partial enthalpies of these elements in Sn were obtained from these measurements: $\Delta H_{Dy} = -36.44$ kcal·at-g^{-1} and $\Delta H_{Er} = 29.25$ kcal·at-g^{-1}. (France)

25221 PRECIPITATION PROCESS IN THE ALLOY COBALT–TUNGSTEN–TITANIUM. Berezina, A. L.; Gun'ko, L. P.; Chuistov, K. V. (Inst. of Metal Physics, Kiev). Fiz. Metal. Metalloved.; 34: No. 6, 1213-1218(1972). (In Russian).

Separation of phases in Co–W–Ti alloy (7.8 at.% W; 3.6 at.% Ti) at 500 to 600°C was studied by x-ray diffraction and electron microscopy. An intermediate β'-phase with a $L1_2$ structure was noted, with a suggested composition of $Co_3(W,Ti)$. Its formation was accompanied by x-ray satellites and maxima reflections from the cubic matrix (β-phase). An interrupted decomposition along the grain boundaries of the stable phase Co_7W was observed. Aging the Co–W–Ti alloy at 800 to 1000°C was characterized by continuous phase separation. (tr-auth)

25222 PECULIARITIES OF STRUCTURE AND PLASTIC DEFORMATION OF ZIRCONIUM SATURATED BY NITROGEN AND

OXYGEN. Azhazha, V. M.; V'yugov, P. V.; Ryabchikov, L. N.; Finkel, V. A. (Physical-Technical Inst., Kharkov). Fiz. Metal. Metalloved., 34: No. 6, 1298-1300(1972). (In Russian).

The effects of saturating Zr of two types with N_2 and O_2 at low pressure on the mechanical properties, plastic deformation, and structure were studied. Specimens of "iodide zirconium" and a purer variety obtained by zone melting were used. The character of the effect of N_2 on the mechanical properties of Zr was different at small and large concentrations. Saturation of Zr with O_2 did not produce lattice distortions in the α phase. (KSW)

25223 INTERCRYSTALLINE DISINTEGRATION OF MOLYBDENUM. Kiseleva, V. N.; Nikishanov, V. V.; Popova, Yu. S.; Shulepov, V. I.; Yudkovskii, S. I. Fiz. Metal. Metalloved.; 34: No. 6, 1314-1316(1972). (In Russian).

Investigation of the submicrostructure of cast Mo at the grain boundaries revealed a dispersed separation constituting a second phase composed of carbides. The quantity of the second phase was much smaller within the grain itself. The existence of the second phase resulted in a stress within the crystal lattice similar to that caused by a hydrostatic pressure. This stress was defined mathematically in terms of the modulus of elasticity of the matrix and other parameters. (KSW)

25224 DIFFUSION OF SULFUR IN SINGLE-CRYSTAL TUNGSTEN. Iovkov, V. P.; Panov, A. S.; Ryabenko, A. V. Fiz. Metal. Metalloved.; 34: No. 6, 1322-1323(1972). (In Russian).

The diffusion of the radioisotope ^{35}S in a single crystal of W at 1900 to 2200°C was studied. The data indicated that the activation energy of diffusion of S was smaller than that of W self-diffusion. The lattice parameter for W saturated with S was smaller than that for pure W. (KSW)

25225 ELECTRICAL RESISTANCE OF HYDROEXTRUDED BERYLLIUM AND ANNEALED BERYLLIUM. Papirov, I. I.; Stoev, P. I.; Taranenko, I. A. (Physical-Technical Inst., Kharkov). Fiz. Metal. Metalloved.; 34: No. 5, 1022-1026(1972). (In Russian).

The electrical resistance of deformed Be (by hydroextrusion) below room temperature was greater than that of the original polycrystalline Be by about 2.5 Ω-cm. The R vs T curves were approximately parallel from 20 down to −200°C. Annealing the hydroextruded Be at 600°C restored the original resistance; the activation energy of the process was calculated from the restoration vs annealing-temperature data to be about 18 kcal/mole. (KSW)

25226 STRUCTURAL MICROHETEROGENEITY IN CADMIUM, BISMUTH, INDIUM, TIN, AND LEAD MELTS. Lad'yanov, V. I.; Arkharov, V. I.; Novokhatskii, I. A.; Kisun'ko, V. Z. (Physical-Technical Inst., Donetsk, USSR). Fiz. Metal. Metalloved.; 34: No. 5, 1060-1065(1972). (In Russian).

The kinematic viscosity V of liquid Cd, Bi, In, Sn, and Pb was measured over a broad temperature interval (from room temperature up to 1400°C in some cases). The V = f(T) curves were generally exponential, becoming linear some 200 to 500° above the melting point. This behavior was interpreted in terms of clusters, short-range order, and disorder as related to a quasi-crystalline model. (KSW)

25227 TEMPERATURE DEPENDENCE OF ELECTRICAL RESISTANCE AND THERMAL EXPANSION OF DYSPROSIUM. Petrenko, N. S.; Popov, V. P.; Semenenko, E. E.; Tutov, V. I.; Khotkevich, V. I. (Physical-Technical Inst., Kharkov). Fiz. Metal. Metalloved.; 34: No. 5, 1105-1106(1972). (In Russian).

The electrical resistance of Dy (99.8% pure) was measured over the temperature range 4.2 to 300°K. A pronounced break in the linearity of the R = f(T) curve occurred at 179°K. The thermal expansion of Dy was measured with a quartz dilatometer over the same temperature range. Between 75 and 150°K a strong hysteresis effect was noted: a large hump appeared in the heating curve (12°/min) in this temperature region, but the hump was missing completely in the cooling curve (12°/min). (KSW)

25228 DISLOCATION STRUCTURE OF SINGLE CRYSTALS OF TUNGSTEN GROWN BY ELECTRON-BEAM ZONE MELTING. Sidokhin, E. F.; Chupyatova, L. P.; Pikunov, M. V. (Inst. of Metal Science and Physics of Metals, Moscow). Fiz. Metal. Metalloved.; 34: No. 4, 849-855(1972). (In Russian).

The dislocation structure of tungsten crystals was studied by a method using anomalous passage of x rays. The sample consisted of a single crystal of W that had been grown during an electron-beam zone-melting technique. A Burgers-vector analysis was conducted using conditions of null contrast, which shed light on the character of dislocation distribution for various crystal sections. A model of dislocation structure for the W single crystals investigated is discussed. (tr-auth)

25229 CONCENTRATED INHOMOGENEITIES IN THE SOLID SOLUTION Ni−10 AT.% Mo. Iveronova, V. I.; Katsnel'son, A. A.; Silonov, V. M.; Lopatin, Yu. V. (Moscow State Univ.). Fiz. Metal. Metalloved.; 34: No. 4, 830-835(1972). (In Russian).

The alloy Ni−Mo (10 at.% Mo) was investigated uwing diffusion and small-angle scattering of x rays. In addition to the fundamental phase, a solid solution of Mo in Ni occurs in a hexagonal phase Ni_3Mo. The experimental change in small-angle scattering and the Laue pattern denoted a growth in the dimensions of a region enriched in Mo and the degree of enrichment. (tr-auth)

25230 THERMAL DIFFUSION OF THALLIUM AND ZINC IN THE LIQUID ALLOYS TIN−THALLIUM AND INDIUM−ZINC. Kuz'menko, P. P.; Golovinskii, L. P.; Ogorodnik, V. A.; Osadchaya, N. V. (Kiev State Univ.). Fiz. Metal. Metalloved.; 34: No. 4, 762-767(1972). (In Russian).

The concentration dependence of thermal diffusion parameters of Tl and Zn was investigated in the liquid metal systems Sn−Tl and In−Zn. The ratios of the scattering cross sections of the components for phonons explained the sign of the thermal transport, and within the limits of error were independent of their concentrations. (tr-auth)

25231 HIGH-PRESSURE POLYMORPH OF THULIUM: AN X-RAY-DIFFRACTION STUDY. Liu, L. G.; Bassett, W. A.; Liu, M. S. (Univ. of Rochester, NY). Science; 180: No. 4083, 298-299(20 Apr 1973).

An x-ray-diffraction study of Tm at room temperature and high pressure by means of a diamond-anvil press showed that Tm transforms from a hexagonal close-packed structure to the samarium type, as other rare-earth elements (Gd, Tb, Dy, and Ho) do. Unlike the other rare-earth elements, hcp Tm has an axial ratio (c/a) that is independent of pressure within experimental error and the transition is reversible. The transition occurs with increasing pressure in the range of 60 to 116 kilobars. The lattice parameters of the samarium-type phase of thulium at about 116 kilobars are a = 3.327 ± 0.005 Å and c = 23.48 ± 0.04 Å, and the volume change at the transition is estimated to be −0.5% of the volume of the hcp phase at the transition. (auth)

25232 PARAMETRIZATION OF LOW-TEMPERATURE DEFORMATION CHARACTERISTICS IN SINGLE CRYSTALS OF MOLYBDENUM. Amin, Kamal E.; Murty, K. Linga; Dorn, John E. (Inorganic Materials Research Division, Lawrence Berkeley Laboratory, University of California, Berkeley, California 94720). J. Appl. Phys. 44: No. 2, 615-618 (Feb 1973).

The flow stress as a function of strain was measured in the temperature range from 77 to 400 °K at strain rates between 10^{-1} and 10^{-6} sec^{-1} for single crystals of molybdenum. The flow stress is characterized by a rate–temperature parameter, defined through a general rate equation for low temperature thermally activated deformation processes in bcc structures. This parameter was utilized for testing the mechanical equation of state and in explaining the failure of such an equation in molybdenum. Whereas the rate of work hardening was found to be uniquely defined by strain and the parameter, the flow stress depended in addition on the thermal–mechanical history of the material. (auth)

25233 DWELL TIMES OF EXPLODING TUNGSTEN WIRES IN AIR. Vlastós, Antonios E. (The Royal Institute of Technology, 100 44 Stockholm 70, Sweden). J. Appl. Phys. 44: No. 2, 628-635 (Feb 1973).

The paper deals mainly with the voltage dependence of the dwell times of 130–mm–long tungsten wires with diameters of 0.05, 0.10, 0.15 and 0.20 mm. The results of the measurements reported show that tungsten wires have dwell times of only the short type, that the restrikes are always initiated at the exterior of the wires, and that during the dwell times tungsten wires have higher conductivity than copper or constantan wires. At low voltages the dwell times increase with increasing wire diameter. However, above 10 kV the dwell times within the range of experimental error, are equal for all the diameters examined. A comparison with the results obtained from exploding copper wires with the same diameter shows that at low voltages the short dwell times of the copper wires are shorter than those of the tungsten wires and that at higher voltages the dwell times of the tungsten wires become much shorter than those of the copper wires, decreasing monotonically with increasing voltage. The special features of the exploding wires during the dwell times and the restrike phase are illustrated by films made by a rotating–mirror streak camera, a camera with a Kerr–cell shutter, and an image–converter camera. (auth)

25234 COMBINATIONS OF THIRD-ORDER ELASTIC CONSTANTS OF ZINC AND CADMIUM. Powell, B. E. (West Georgia College, Carrollton, Georgia 30117); Skove, M. J. J. Appl. Phys. 44: No. 2, 666-667 (Feb 1973).

Deviations from Hooke's law are caused by the third–order elastic

constants. These deviations have been measured for one orientation of cadmium and two orientations of zinc filamentary crystals (whiskers). Expressions for these deviations have been derived and used to calculate values of the linear combinations of third-order moduli. The experimental values of the deviations for zinc are compared with values calculated from published third-order constants. (auth)

25235 FIELD ION MICROSCOPE STUDY ON THE INTERACTION OF GALLIUM WITH METALS. II. ALLOY FORMATION WITH MOLYBDENUM AND ANISOTROPIC BINDING FORCE IN Mo_3Ga. Nishikawa, O.; Utsumi, T. (Bell Laboratories, Murray Hill, New Jersey 07974). J. Appl. Phys. 44: No. 3, 955-964 (Mar 1973).

Gallium was deposited on a molybdenum tip by making contact between the tip and liquid gallium in vacuum. Pseudomorphic gallium could not be observed clearly. The product of the Mo–Ga reaction above 600 °C was found to be the ordered alloy, Mo_3Ga, with the β–W structure and no other structure was observed. The difference between the crystal structure and the observed image of the (001), (130), (120), and (110) planes of the alloy are explained by the unobservability of the gallium atom and by the variation of the stability of the molybdenum surface atoms. The observed differences in the stability of the surface atoms on these planes are interpreted in terms of anisotropic binding forces in the β–W structure of the alloy. (auth)

25236 FIELD ION MICROSCOPE STUDY ON THE INTERACTION OF GALLIUM WITH METALS. I. PSEUDOMORPHIC STRUCTURE AND SUPERSTRUCTURES ON TUNGSTEN. Nishikawa, O.; Utsumi, T. (Bell Laboratories, Murray Hill, New Jersey 07974). J. Appl. Phys. 44: No. 3, 945-954 (Mar 1973).

Gallium was deposited on a tip specimen of a field ion microscope by making contact in vacuum. Gallium deposited on a tip area and diffused from the tip shank at 350 to 500 °K was crystallized in the pseudomorphic structure on tungsten. The number of atomic layers of the pseudomorphic gallium was 2 to 3. The sharp helium image of the pseudomorphic gallium appeared at a voltage considerably lower than the helium best-image voltage for tungsten. The observed high evaporation field of the pseudomorphic gallium, 3.0–4.5 V/Å, may indicate that the gallium atoms in the pseudomorphic state are anomalously strongly bound to the substrate tungsten or are field evaporated as the doubly-ionized ions. Various superstructures were observed on the {112} areas after heating above 900 °K, but their detailed structures did not depend upon temperature or heating time. An unidentified underlayer may play a dominant role in determining the structure of the superstructures. No clear evidence of alloy formation was noticed in the temperature range 21 to 1500 °K. (auth)

25237 ELASTIC CONSTANTS OF Ti–40 AT.% Nb AT 298 °K. Reid, C. N. (The Open University, Bletchley, Buckinghamshire, England); Routbort, J. L.; Maynard, R. A. J. Appl. Phys. 44: No. 3, 1398-1399 (Mar 1973).

The single-crystal elastic constants of a commercial superconducting alloy Ti–40 at.% Nb have been measured at 298 °K. The results are $C_{11}=156.5\pm0.4$ GPa, $C_{12}=111.6\pm0.4$ GPa, $C_{44}=39.63\pm0.08$ GPa, and $C'=22.47\pm0.04$ GPa. The value of C' predicted by an empirical expression involving the effective electron-to-atom ratio, e^*/a is 16% smaller than the measured value. The β-alloy was found to be stable to 78 °K. (auth)

25238 ELASTO-PLASTIC ANALYSIS OF CONSTRAINED DISK BURST TESTS. Riccardella, P. C. (Westinghouse Nuclear Energy Systems, Pittsburgh). J. Eng. Ind.; 95: No. 1, 129-136(Feb 1973).

The PVRC Subcommittee on Effective Utilization of Yield Strength has conducted an extensive series of pressurized burst tests on constrained disk specimens of seven steels. Elasto-plastic analyses have been performed for nine of these tests; test results are presented. Good agreement between the analytical and experimental results all the way to failure pressure is illustrated by a comparison of centerline deflections. Interpretation of the analytical data indicates that both edge type and center-line type of failures are correlated reasonably well by the conventional reduction in area from a uniaxial tensile test once triaxiality is accounted for. (auth)

25239 EVALUATION OF Mn–Mo AND THE MECHANICAL PROPERTIES OF Mn–Mo–Ni STEELS. Swift, R. A.; Gulya, J. A. (Lukens Steel Co., Coatesville, PA). J. Eng. Ind.; 95: No. 1, 235-242(Feb 1973).

A study of the effects of normalizing and austenitizing on the mechanical properties of Mn–Mo and Mn–Mo–Ni steels is presented. It is shown that the quenched and tempered condition has superior notch toughness, elevated temperature tensile properties, and creep ductility than the normalized and tempered condition. The basis of comparison used for strength is the percentage of the room temperature strength. The creep strength and rupture resistance of the normalized and tempered condition are better than those of the quenched and tempered condition. Also, a comparison of the properties of the steels is made to evaluate the effects of a 0.5% Ni addition. While it improves hardenability, Ni tends to impair the elevated temperature creep strength and rupture resistance. Significant effects of Ni are seen on the elevated temperature tensile properties. The loss in ultimate tensile strength with increasing temperature is greater for the Ni modified grade than for the unmodified Mn–Mo. In the quenched and tempered condition, both yield strength and ultimate tensile strength are less affected by temperature when no Ni is added. (auth)

25240 HYDROSTATIC-PRESSURE DERIVATIONS OF THE SINGLE-CRYSTAL ELASTIC MODULI OF Gd, Dy, AND Er. Fisher, E. S.; Manghnani, M. H.; Kikuta, R. (Univ. of Hawaii, Honolulu). J. Phys. Chem. Solids; 34: No. 4, 687-703(Apr 1973).

The hydrostatic pressure derivatives of the single-crystal elastic moduli of Gd, Dy, and Er were measured at 298°K, to pressures near 5 kbar. The very small pressure derivatives of the adiabatic bulk moduli indicate that a small ion-core model should be appropriate for interpreting the data. The long-range electrostatic contributions to the shear moduli have a dominant influence on the pressure derivatives of the shear moduli of Er, whereas the Gd and Dy data evidently reflect band structure contributions. The values of the longitudinal stiffnesses correspond remarkably well with the Bohm–Staver model for velocity of waves in an ion plasma dispersed in a sea of electrons, where the ionic interaction is purely Coulombic. This model is extended to provide an interpretation of the volume derivatives of the longitudinal moduli in terms of the volume derivative of the density of the electron states at the Fermi energy. The Grueneisen parameters calculated from averages of the acoustic model gammas are in relatively poor agreement with those determined from thermal expansion data. An explanation based on the changes in c/a ratio with volume change is tested quantitatively and found to be reasonably successful. The values of dK_T/dP, where K_T is the isothermal bulk modulus, are applied to the Murnaghan equation of state and give excellent agreement with Bridgman's direct compression data for Dy and Er to 40 kbar. For Gd, Bridgman's data indicate either that $(dK_T/dP)_{P=0}$ should be considerably larger than deduced from the adiabatic dK_S/dP measurements or that a phase change occurs near 20 kbar. The occurrence of a phase change in Er at ~90 kbar is definitely indicated when comparing the Murnaghan equation with x-ray-diffraction data. (auth)

25241 PLUTONIUM–DOKUMENTATION. Referate-Zeitschrift mit Anhang Transplutonium-Elemente. January 1973. Band 7, Heft 1. 210 Referate (Register-Nr. 1-425); 93 Referate (Register-No. 1T-93T). ((Plutonium Documentation. Abstract Journal with Appendix on Transplutonium Elements). January 1973. Volume 7, No. 1. 210 Abstracts (Register No. 1-425); 93 Abstracts (Register No. 1T-93T)). Karlsruhe, Ger.; Gesellschaft fuer Kernforschung m.b.H. (1973). 114p. (In German and English).

25242 FRACTURE MECHANICS OF BRITTLE MATRIX DUCTILE FIBER COMPOSITES. Tardiff, G. Jr. Eng. Fracture Mech.; 5: No. 1, 1-10(Feb 1973).

A model to predict the increase in critical flaw size or stable crack growth potential which can occur by the inclusion of ductile fibers in a brittle matrix is considered. The model is based upon the superposition of two known stress intensity solutions; one for the crack opening mode resulting from a remotely applied stress and the second, an opposing stress intensity that results from a crack closing force exerted by unbroken fibers spanning the crack surfaces. The extent of stable growth possible is computed at the ultimate stress of the brittle phase as functions of fiber strength and of volume fraction for various amounts of fiber rupture. A hot-pressed beryllium matrix is used as an example. The crack surface displacement over which a given fiber is capable of deforming without rupture is found to be sensitive to the fiber/matrix interface strength. The factors leading to maximum crack surface displacement without rupture are a high-strain-hardening capability of the fiber and an interface designed to fail at fiber stresses between yield and ultimate strengths. (auth)

25243 INFLUENCE OF BORON ON THE CREEP PROPERTIES OF AUSTENITIC STEELS. Lagerquist, M. (Aktiebolaget Atomenergi, Stockholm); Lagneborg, R. Scand. J. Met.; 1: No. 2, 81-89(1972).

Various attempts have been made to explain the boron effects on stainless steels. In order to study pinning between boron atoms and vacancies, measurements have been made of the recovery of the electrical resistivity in cold-worked, boron-doped highly pure nickel. These measurements suggest that there is no significant

pinning between boron atoms and vacancies. The possibility that boron retards the condensation of vacancies on creep cracks and reduces their growth is therefore rejected. Another hypothesis that has been explored is the possibility that boron by some means retards the rate of grain-boundary sliding. Measurements of grain-boundary sliding have therefore been carried out for a boron-free and a boron-bearing 20% Cr–15% Ni steel. Conventional creep tests were also made for these materials. The microstructure of the creep tested specimens was examined by electron microscopy, particularly with respect to precipitation. It was shown that boron strongly promotes precipitation of $M_{23}C_6$ during creep at 100°C. In boron-doped 20% Cr–35% Ni alloy $M_{23}C_6$ was precipitated, both intergranularly and in the grain interior. This was in contrast to the boron-free material where $M_{23}C_6$ formed only in grain boundaries. Owing to the fine intercrystalline precipitation of $M_{23}C_6$, the creep rate was reduced in the 20% Cr–35% Ni–B steel as compared with the boron-free 20% Cr–35% Ni alloy. The ratio between the grain boundary sliding and the total creep strain as a function of stress was, in the first step, the same for the various alloys. This indicates a strong coupling between the grain boundary sliding and the grain deformation. (SW)

25244 PHASE DIAGRAM OF THE ZIRCONIUM–COPPER–MOLYBDENUM SYSTEM AT TEMPERATURES FROM 900 TO 600°C. Tregubov, I. A.; Ivanov, O. S. pp 67-71 of Diagrammy Sostoyaniya Metal. Sistem. Moscow; Izdatel'stvo Nauka (1971). (In Russian).

Microstructural and x-ray analyses, measurement of hardness, microhardness, and specific electrical resistance were used in a study of the Zr-rich alloys of the Zr–Cu–Mo system with Zr contents of 90 and 98.95 at.%, isothermal sections being made at 600, 700, 800, and 900°C. When quenched from 900°C the β solid solution undergoes a transformation with the formation of the metastable α', α'', ω, and β phases. (Metals Abstr.)

25245 EXPERIMENTAL DETERMINATION OF RESIDUAL ELASTIC–PLASTIC DEFORMATION IN BUTT JOINTS OF A ZIRCONIUM–NIOBIUM ALLOY. Steklov, O. I.; Luchkin, R. S. Avtomat. Svarka; No. 2, 29-31(Feb 1972). (In Russian).

Samples of Zr–2.5% Nb were fabricated by butt welding. The deformation was released by cutting up the samples. Measured deformations were interpreted as residual stresses and presented as functions of the distance from the line of the weld. Residual plastic deformations are also presented. (Metals Abstr.)

25246 CAVITATION. Piatti, G.; Lubek, 56.; Matera, R. Euro-Spectra; 11: No. 4, 93-101(Dec 1972).

Microcrack formation and propagation phenomena in creep-deformed metals are investigated and interpreted on the basis of the results of various tests (creep tests, density measurements, and quantitative metallographic analysis) carried out on various materials at Ispra. (auth)

25247 VAPOR PRESSURE OF URANIUM OVER URANIUM MONOCARBIDE. Solov'ev, G. I. Met. Metalloved. Chist. Metal., Sb. Nauch. Rabot; No. 9, 80-84(1971). (In Russian).

The Langmuir method was used to determine the vapor pressure of U over $UC_{0.97}$ and $UC_{1.0}$. The temperature–vapor pressure equations are: $\log p = 8.73 - 27{,}000/T$ and $\log p = 8.50 - 29{,}500/T$, respectively (p in torr), from which heats of sublimation of 124 and 135 kcal/g atom, respectively are obtained. (Metals Abstr.)

Radiation Effects

Refer also to abstracts 25094, 25320, 26567, 26644, 26652, and 26712.

25248 (ANCR-1096) FATIGUE AND CREEP-FATIGUE BEHAVIOR OF IRRADIATED STAINLESS STEELS: AVAILABLE DATA, SIMPLE CORRELATIONS, AND RECOMMENDATIONS FOR ADDITIONAL WORK IN SUPPORT OF LMFBR DESIGN. Brinkman, C. R.; Beeston, J. M.; Korth, G. E. (Aerojet Nuclear Co., Idaho Falls, Idaho). Feb 1973. Contract AT(10-1)-1375. 29p. Dep. NTIS $3.00.

Experimental data that have been reported concerning the fatigue and creep-fatigue behavior of irradiated austenitic stainless steel of concern for LMFBR design are presented. The limited data are reviewed and it is tentatively concluded that the reductions or increases in fatigue lifetimes resulting from irradiation can be qualitatively explained in terms of strength and ductility changes reflected in tensile properties. Since irradiated fatigue data covering all possible combinations of temperature, fluence, and strain rate of concern in design will probably never be available, methods of estimating irradiation effects on expected fatigue lifetimes will probably have to be developed. One such method is discussed and compared with experimental results. The influence of elevated temperature tensile hold times on the fatigue behavior of irradiated stainless steels is discussed; however, no method of estimating the effect of hold times for design purposes is recommended. Current work in progress as well as recommendations for additional work is discussed. (auth)

25249 (CEA-R-4382) STUDY OF THE SWELLING OF NEUTRON-IRRADIATED MAGNESIUM. Levy, R. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Jan 1973. 68p. (In French). Dep. NTIS (U. S. Sales Only) $5.50.

Thesis. Submitted to Paris Univ., Orsay (France).

The swelling of fast-neutron-irradiated magnesium was investigated for $0.3\ T_m < T < 0.5\ T_m$. Up to a fluence of 10^{21} n/cm^2, the dose dependence of swelling is almost linear and the swelling is more important than for other pure metals. The nucleation of voids seems to be connected with faulted loops created by irradiation. An important decrease in swelling is caused by the addition of 4000 ppM Zr. Because of the high concentration of radiation-induced dislocations, the swelling of magnesium is not influenced by the initial cold work of the metal. (auth)

25250 (NIIAR-P-114) HIGH-TEMPERATURE RADIATION EMBRITTLEMENT OF Ni TAKEN AS AN EXAMPLE. Balashov, V. D.; Votinov, S. N. (Scientific Research Atomic Reactor Inst., Melekess (USSR)). 1971. 19p. (In Russian). INIS.

Mechanical and structural tests were conducted on samples of cold-worked electrolytic nickel, both unirradiated and irradiated in the SM-2 reactor at 70°C at an integrated flux of 8×10^{20} n/cm^2. The exposure to neutrons caused embrittlement at the test temperature of 650°C. A similar embrittlement effect may be obtained in nonirradiated samples through a decrease in the rate of heating up to the test temperature. High-temperature annealing resulted in a recovery of its ductility. A retardation in recrystallization processes was noted in samples that had been irradiated as compared with the controls. These results were interpreted in terms of radiation-induced acceleration of diffusion in the nickel. (tr-auth)

25251 (TRG-Report-2385) FURTHER CREEP EXPERIMENTS IN THE DOUNREAY FAST REACTOR. Mosedale, D.; Lewthwaite, G. W.; Ramsay, I. (United Kingdom Atomic Energy Authority, Dounreay (Scotland). Reactor Group). Jan 1973. 14p. (CONF-721115-5). Dep. NTIS (U. S. Sales Only).

From European conference on irradiation embrittlement and creep in fuel cladding and core components; London,

The findings from further irradiation of helices, loaded in tension and immersed in sodium at temperatures of about 280°C, in the inner breeder of the Dounreay Fast Reactor are presented and discussed. Specimen materials comprised eight austenitic stainless steels, Nimonic PE16 alloy, and nickel. Seven of the steels were studied in both cold-worked and solution-treated conditions, one in only the former. The Nimonic alloy was exposed in solution and fully heat-treated conditions and the nickel was annealed. Higher fluence data points largely substantiate trends previously reported, irradiation creep appearing to continue at a steady rate after an initial non-linear dependence on displacement damage. Further observations of annealed steels irradiated in low flux positions suggest that these materials initially accelerate in creep rate before slowing down to a steady state. Progress is reported in work aimed at characterizing more fully the materials of these experiments. It appears that the degree of prior work hardening, as evidenced in hardness values, conditions the amount of primary irradiation creep of the stainless steels. This confirms and reinforces the earlier observations that the cold-worked steels showed, in general, more transient creep than annealed specimens from the same batches. The Dounreay Fast Reactor spring results are discussed in relation to other experimental findings and predictions from theory. (auth)

25252 VOIDS IN IRRADIATED ALUMINUM ALLOYS. Mayer, R. M.; Morris, E. T. (Atomic Energy Board, Pretoria). Nature (London) Phys. Sci.; 241: No. 111, 132-133(12 Feb 1973).

Some results are given on the effect of alloying elements in substitutional solid solution on the nucleation of voids in irradiated pure Al and its binary alloys. The alloys investigated comprised those with small quantities of In or Si. Transmission electron microscopy revealed the presence of voids in the pure metal, Al–0.04% In and Al–0.005 Si; voids were not observed in Al–0.01 Si. All voids were uniformly dispersed throughout the foils and were polyhedral though not necessarily regular in shape. In increased the number of voids, but their average size remained the same; 50 ppM Si increased the size, but reduced the number of voids; 100 ppM Si suppressed the nucleation of voids, but promoted the nucleation of dislocation loops. Irradiations were carried out in

the SAFARI-1 reactor to a dose of 2.5×10^{20} n/cm^2 (E > 0.1 MeV). Mechanisms are discussed. (UK)

25253 MATERIALS PROBLEMS IN SPACE. Dauphin, J. (European Space Research and Tech. Centre, Noordwijk, Netherlands). Int. J. Environ. Stud.; 4: No. 2, 109-115(Jan 1973).

The paper is a short survey of the materials problems associated with spacecraft design and manufacture. Included in the sections dealing with the space environment and the special materials technology necessary to overcome the difficulties that arise therefrom there is a discussion on radiation fluxes and radiation effects. Particle fluxes encountered range from a few keV to a few GeV and include auroral electrons, radiation-belt electrons, outer-belt protons, solar-flare protons, inner-zone trapped protons and cosmic radiation. The possible effects of particle radiation on materials due to absorption phenomena including ionization and excitation are considered. The possible damage to metals, ceramics, and inorganic pigments of paints caused by the appearance of vacancies and interstitials giving rise to changes in mechanical, thermal, and electrical properties are discussed. (UK)

25254 INFLUENCE OF NEUTRON RADIATION ON THE RECRYSTALLIZATION OF DEFORMED COPPER. Klyushin, V. V.; Golovachev, M. G.; Kurushin, S. P. Fiz. Metal. Metalloved.; 34: No. 5, 1109-1110(1972). (In Russian).

Copper of 99.99% purity was deformed 5, 10, and 40% before being subjected to neutron radiation in integral flux doses from 5×10^{18} to 10^{20} n/cm^2, the irradiation temperature being 70°C. A neutron dose of 10^{20} n/cm^2 decreased the temperature region of recrystallization; the initial temperature was raised, and the final temperature of recrystallization was lowered by the radiation dose. The lower radiation dose behaved somewhat erratically in this respect. (KSW)

25255 INHIBITION OF RADIATION BLISTERING IN TIN BOMBARDED BY PROTONS AND ALPHA PARTICLES. Mikkelson, R. C.; Miller, J. W.; Holland, R. E.; Gemmell, D. S. (Argonne National Laboratory, Argonne, Illinois 60439). J. Appl. Phys. 44: No. 3, 935-937 (Mar 1973).

Tin monocrystals have been bombarded with large doses ($\sim 5 \times 10^{17}$ particles/cm^2) of 1.5–4–MeV ions of H and He. Proton irradiations above 225 °C produce neither visible surface damage nor degradation of the ability of a crystal to channel the incident particles. Room-temperature irradiations by H or He ions produce little observable damage near the crystal surfaces unless followed by post-irradiation anneals to 220 °C or above. After such anneals, however, channeling measurements show permanent deterioration and the surfaces may show deformations such as swelling, blistering, and effervescence. (auth)

25256 ELLIPSOMETRIC OBSERVATIONS OF AN ELECTRON-BOMBARDED STAINLESS STEEL SURFACE. Fane, R. W.; Neal, W. E. J.; Latham, R. V. (Department of Physics, University of Aston in Birmingham, Birmingham, B4 7 ET,). J. Appl. Phys. 44: No. 2, 740-743 (Feb 1973).

It has been established, by electrical and electron-optical studies, that the oxide surface layer is responsible for the particularly stable properties of stainless steel when used for high-voltage electrodes. The growth of this surface oxide has been studied ellipsometrically. After cleaning the surface by electron bombardment the growth of the layer was monitored in the pressure range 10^{-8} Torr–atmospheric pressure, and the temperature range 300–1300 °K. The equilibrium thickness at room temperature and at atmospheric pressure is ~30 A. A temperature in excess of 1000 °C is required to remove the film at 10^{-8} Torr. (auth)

25257 DIMENSIONAL INSTABILITY IN IRRADIATED URANIUM. Hudson, B. J. Sheffield Univ. Met. Soc.; 11: 43-49(1972).

The use of "Magnox" fuel elements for nuclear reactors and irradiation damage are reviewed. The processes, which can cause dimensional instability of U in reactors, are outlined. Electron microscopic study is described, which presents some help in understanding the swelling mechanism. The combination of bubble-sweeping mechanism and induced cavity growth of the subsequent agglomerations may explain some of the observed swelling features. (27 references) (Metals Abstr.)

Other Materials

Refer also to abstracts 24557, 25094, 25277, 25320, 27068, and 27072.

25258 (AD-810423) BORON. Milek, J. T.; Welles, S. J. (Hughes Aircraft Co., Culver City, Calif. Electronics Properties Information Center). Feb 1967. Contract AF33(615)-2460. 266p. (EPIC-DS-151). NTIS.

A state-of-the-art survey and data sheet compilation on elemental boron is presented. The thorough literature search uncovered 304 references that were evaluated for information and data on the reduction preparation methods, zone-refining and melting techniques, crystal structures, electrical properties, optical properties, thermal and thermodynamic properties, physical and chemical properties, metallurgy and mechanical properties, applications, availability and suppliers. Major emphasis was the characterization of boron's semiconductive and acoustic properties with respect to potential semiconductor and delay-line devices. Detailed information on the various methods of preparing pure boron and the resulting crystal structures plus properties are summarized in tables. (auth)

25259 (JAERI-M-4750) PHASE DIAGRAM AND THE DATA FOR LIQUID METALS AND INORGANIC MOLTEN SALTS: Li_2BeF_4. Ohno, H.; Ohmichi, T.; Furukawa, K. (Japan Atomic Energy Research Inst., Tokyo). Mar 1972. 49p. (In Japanese). NTIS (U. S. Sales Only).

For Li_2BeF_4, a promising coolant, a phase diagram and data are presented on physical properties including density, viscosity, vapor pressure, surface tension, and thermal conductivity. Data are also included on thermodynamic properties such as heat capacity, heat of fusion, enthalpy, entropy, solubility, electrochemical properties, and optical properties, such as Raman spectra. (auth)

25260 RATE OF OXIDATION OF THE BASAL AND PRISMATIC SURFACES OF PYROLYTIC GRAPHITE IN THE TRANSITION REGIME BETWEEN CHEMICAL AND DIFFUSIONAL CONTROL. Acharya, T. R.; Olander, D. R. (Univ. of California, Davis). Carbon; 11: No. 1, 7-18(Feb 1973).

Reaction rates of oxygen with the basal and prism faces of pyrolytic graphite have been measured using a rotating disk contactor. Temperature ranged from 1100 to 2000°K and oxygen concentrations from 0.05 to 1% in helium and argon at atmospheric pressure. The intrinsic rate of the surface reaction and the magnitude of the mass transfer coefficients attainable from the rotating disk placed most of the experiments in the transition regime between the limits of chemical and diffusional control of the overall process. Surface chemical rate constants were extracted from the data with the aid of the theory of rotating disk mass transfer. Kinetic expressions for the oxidation of the basal and prism planes were obtained. The rate expression of Strickland–Constable fell in between the rates determined here for the basal and prism orientations. (auth)

25261 ARTIFICIAL GRAPHITES. Clause, J. (Societe le Carbone Lorraine, Paris); Cornuault, P. Chim. Ind., Genie Chim.; 105: No. 23, 1569-1575(Nov 1972). (In French).

Artificial graphites are refractory products used in the electrical, chemical, and thermal industries and recently in the nuclear and space industries. They are manufactured by the extrusion or molding of coke with a binder material (pitch or resin) followed by baking in a gas furnace at 1000°C and subsequent graphitization at 2800°C in an electric furnace. During the manufacturing process, it is possible to change the properties of these products by impregnating them with pitch. The impregnating of these graphites with resins causes them to become impervious, rendering them suitable for particular applications. (France)

25262 RADIATION-INDUCED DAMAGE IN PILE GRAPHITE. Correlation Between Temperature and Flux Density at High Temperature. Genthon, J. P.; Michaud, G. (CEN de Saclay, Gif-sur-Yvette, France). High Temp.–High Pressures; 4: No. 3, 339-342(1972). (In French).

A series of in-pile irradiation experiments on graphite provides support and more precise data for a model postulating that an elementary defect induced by one neutron collision is of the displacement zone type. A value Q = 4 eV has been found for the lowest activation energy of vacancy type defects in the displacement zone. It is suggested that this value is used for the "equivalent temperature" correction in the temperature range 600 to 1400°C. (auth)

25263 STRESS–STRAIN CHARACTERISTICS OF NONIRRADIATED AND IRRADIATED NUCLEAR GRAPHITES. Everett, M. R.; Ridealgh, F. (Atomic Energy Establishment, Winfrith, Eng.). High Temp.–High Pressures; 4: No. 3, 329-337(1972).

The tensile stress–strain and set characteristics of irradiated and nonirradiated Gilsocarbon graphite have been investigated at room temperature and after constant-stress temperature-cycle conditions up to 1100°C. Results from post-irradiation examination of the mechanical properties of annular fuel compacts and graphite irradiated in the Dragon reactor at temperatures in the range 900 to 1200°C and fast neutron doses of up to 3×10^{21} n cm^{-2} Ni Dido are presented. Over this range of irradiation conditions the results indicate a near linear and approximately constant relationship between ultimate tensile strength and Young's modulus,

and support a constant strain-to-failure criterion rather than the usually accepted constant strain-energy criterion. (auth)

25264 EFFECT OF n- AND γ-RADIATION ON THE KINETICS AND MORPHOLOGY OF MEDIUM-DENSITY POLYETHYLENE CRYSTALLIZATION. Boyadzhyan, A. G.; Fikhtner, R. R.; Baranov, V. G.; Frenkel, S. Ya. Izv. Akad. Nauk Arm. SSR, Ser. Fiz.; 7: No. 4, 301-303(1973). (In Russian).

A comparative study of increases in crystallinity degree and in the rate of spherulite growth induced by neutrons and γ-radiation during the isothermal crystallization of medium-density polyethylene was made. The rate of spherulite growth is shown to decrease considerably in irradiated samples, while no changes in the rate of increase of total crystallinity degree could be observed. (auth)

25265 ELECTROLYTE FOR ELECTROCHEMICAL MACHINING OF NIOBIUM AND ITS ALLOYS. Davydov, A. D.; Kamkin, A. N.; Kashcheyev, V. D.; Mityashkin, D. Z.; Klopova, S. V. Russian Patent 315,558. 30 Nov 1971. Filed date 13 Apr 1970. (In Russian).

An electrolyte has been patented for electrochemical machining of Nb and its alloys. It is distinguished by the fact that in order to increase the process stability and the quality of the surface subjected to anodic solution, a bromide salt, for example, NaBr, a nitrate salt, for example, $NaNO_3$, a base, for example, NAOH, H_3BO_3, and water are introduced into its composition. The components are taken in the following proportions (in % by weight): bromide salt 30 to 50, nitrate salt 0.5 to 2, alkali 0.5 to 2, H_3BO_3 3, and the rest water. The proposed electrolyte has been tested on an experimental setup. Flat specimens produced by turning with an area of 8 cm^2 and a class 4 to 5 surface finish were machined. The machining was carried out in a solution of the following composition (% by weight), KBr 45, $NaNO_3$ 1, KOH 1. The electrode gap is maintained within the limits of 0.3 mm, and the electrolyte pressure at the intake to the operating gap is 8 kg/cm^2. When applying a voltage of 6 volts to the system, destruction of the film of Nb pentoxide takes place, and the current strength increases sharply. The rate of anodic solution increases linearly with an increase in D_a. The BT_a is ~70%. The electrolyte temperature is kept within the limits 20± 3° by means of a special refrigerating unit. After machining, a smooth light surface with 6 to 7 class finish was obtained. After passage of 10 A/hour, the pH of the electrolyte decreases from 13 to 9, and the machining quality becomes worse. This can be eliminated by adjusting the electrolyte with alkali, but it is expedient to introduce 3% boric acid into the composition which has a buffering effect and to increase the alkali content to 2% in order not to lower the initial pH value. (JPRS)

NUCLEAR MATERIALS AND WASTE MANAGEMENT

Accountability and Safeguards

Refer also to abstract 25093.

25266 (KFK-902) BASIS OF MATERIAL ACCOUNTANCY FOR SAFEGUARDS IN A CENTRIFUGE PLANT. Otto, R.; Wenk, E.; Kraska, E.; Gupta, D. (Kernforschungszentrum, Karlsruhe (West Germany)). Dec 1972. 22p. (CONF-720678-2). Dep. NTIS (U. S. Sales Only) $3.25.

Two areas of interest in connection with the safeguarding of a centrifuge plant, namely, a critical analysis of a few characteristics of centrifuge plants which are relevant to safeguards and a record-report system for such a plant, are discussed. Some characteristics of a centrifuge plant are conducive to safeguards. The gas phase inventory in the separating part of the cascade is very low. The feed, product and tail streams are all pure UF_6 and are among the most accurately measurable process streams in a nuclear cycle (this is true for all enrichment facilities). These factors permit a simplified balancing system for safeguards. It is not possible to establish the separative work of a centrifuge plant directly during normal operation. However, it is not necessary to have an independent knowledge on separative work (SW) for safeguards purposes. Only two material balance areas are required for a record-report system in the reference centrifuge plant with the capacity of 600 tons U SW/y. The EDP system can be built up in such a way that it can be used for the records and reports for safeguards and for the plant requirement. The same structure can be used for a much simplified record-report system in a smaller size plant. (auth)

25267 (KFK-1696) ASSESSMENT OF MATERIAL UNACCOUNTED FOR (MUF) AND INSPECTION EFFORTS IN A CENTRIFUGE PLANT. Kraska, E.; Otto, R.; Wenk, E.; Avenhaus, R.; Gupta, D. (Kernforschungszentrum, Karlsruhe (West Germany)). Nov 1972. 54p. (CONF-720678-1). Dep. NTIS (U. S. Sales Only).

The problem of safeguarding the nuclear material in a centrifuge plant with the help of material accountancy is analyzed. A reference plant with a separative work of 600 ton U/y and a material flow scheme as it is seen today is considered. In the first part the question of the accuracy of the material balance is analyzed with the help of recently developed techniques: the probability of detection per year is determined as a function of the error of the first kind, the number of inventories and the amount assumed to be diverted per year. In the second part different possibilities for the verification of the operator's reported data are considered. It is shown that it is sufficient to check the gross weights of the UF_6 cylinders with a rough balance by using the sign test method and to check the enrichment of the product and tail streams on a random sampling basis. It is to be noted that the ideas presented are not yet fully developed; further work is in progress. (GF)

Disposal and Storage

Refer also to abstract 25271.

25268 (SZS-137) STORAGE OF RADIOACTIVE WASTES IN SALT FORMATIONS: STAGE OF DEVELOPMENT AND POSSIBILITIES. Franke, H.; Richter, D. (Staatliche Zentrale fuer Strahlenschutz, Berlin (East Germany)). Sep 1972. 53p. (In German). Dep. NTIS (U. S. Sales Only).

Technological possibilities and safety conditions of the storage of low-, intermediate- and high-level radioactive wastes in salt formations are outlined. The stage of development in this field is shown considering the work done in the USA, FRG and GDR. (auth)

Handling Equipment and Procedures

Refer also to abstracts 24824, 24917, 24921, and 25142.

25269 (AECL-4256(Rev.1)) UNIVERSAL CELLS AT THE CHALK RIVER NUCLEAR LABORATORIES. Manson, R. E. (Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.). Jan 1973. 47p. Dep. NTIS (U. S. Sales Only) $4.50. AECL $1.50.

Revised by A. K. Voss.

This general description of the Universal Cells at the Chalk River Nuclear Laboratories was written as part of a submission to the Nuclear Safety Advisory Committee. This revision incorporates the latest modifications to the facilities. (auth)

25270 (RFP-1964) COMPUTER-CONTROLLED XYZ RETRIEVER. Roberts, O. K. (Dow Chemical Co., Golden, Colo. Rocky Flats Div.). 1972. 10p. (CONF-721047-5). Dep. NTIS.

Computer-controlled remote-handling equipment (XYZ Retriever) for storage and retrieval of in-process plutonium at the Rocky Flats Plant is described. (TFD)

25271 (RT/PROT-72-38) HANDMADE CONCRETE CONTAINERS FOR RADIOACTIVE WASTE. RELATIONS BETWEEN INTENSITY OF EXPOSURE AT CONTACT, CONTAINED ACTIVITY, AND CHARACTERISTIC GEOMETRY IN THE CASE OF LOW AND INTERMEDIATE LEVELS OF ACTIVITY. Moccaldi, A.; Rossi, M. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 23 Nov 1972. 25p. (In Italian). Dep. NTIS (U.S. Sales Only) $3.25.

Some shielding calculations for concrete containers for low- and intermediate-level radioactive wastes were carried out. The radioactivity concentrations are plotted against radiation doses and dimensional characteristics of containers. (auth)

25272 (UCID-16144) GLOVE BOX PHOTOGRAPHIC SYSTEM FOR SMALL OBJECTS. Reedy, R. (California Univ., Livermore. Lawrence Livermore Lab.). 6 Nov 1972. Contract W-7405-eng-48. 6p. Dep. NTIS $3.00.

Off-the-shelf photographic hardware cannot produce satisfactory records in many cases. A system designed to take color photographs of very small objects in a glove box is described. (auth)

25273 IMPROVEMENTS TO PUMP EJECTORS. Odic, J.; Prinz, M. (to Commissariat a l'Energie Atomique). French Patent 2,122,640. 1 Sep 1972. Filed date 18 Jan 1971. 8p. (In French).

A demountable tube pump ejector for radioactive or dangerous fluids is presented. This type of ejector is used to circulate radioactive solutions in plants for the reprocessing of irradiated nuclear fuels and also in light water power reactors. The mounting and demounting of the vapor ejector proposed is conveniently carried out from a distance and telemanipulators may be used. The ejector consists of a solid body provided with an output diffuser possessing cross positioned pipes for transferring the vapor and liquid respectively and a nozzle fixed onto a nozzle-holder (the assembly being demountable). The pipe holder is fixed to a tubular extension of the body by a fluid tight joint which enables the easy location of the position of the end part of the nozzle holder and the appropriate orientation for the correct positioning of the pipe leading the vapor into the nozzle. The ejector can be mounted such that the zone along which the fluids are transferred is situated behind a protection block, movable demounting equipment being provided on the other side of this protection block. (FR)

25274 PUMPING ARRANGEMENT COMPRISING MEANS FOR SUBJECTING A FLUID TO BE PUMPED TO REPETITIVE PULSES. Golder, J. A.; Grant, J. (to United Kingdom Atomic Energy Authority). British Patent 1,300,401. 20 Dec 1972. Filed date 27 Jan 1969. 5p.

Pumping arrangements are described that are particularly suitable for pumping "noxious" fluids, such as radioactive materials, liquid sodium, HF, molten salts, etc. The arrangements may also be applicable to valuable materials that must be moved in a fully sealed circuit to ensure no possibility of loss by leakage. The fluid is contained in a chamber having inlet and outlet connections, with a fluid diode arranged so that it can easily leave the chamber, under the influence of the pulses, through the outlet connection, and a second fluid diode in the inlet connection whereby the fluid can easily enter the chamber through the inlet connection, but cannot leave the chamber through that connection. The means for subjecting the fluid to repetitive pulses may comprise a heatable surface in the chamber, the fluid being driven away from the surface and then collapsing back on to the surface to complete a pulse cycle, which is then repeated. A condenser may be used to aid cooling of vapor generated at the heated surface and thereby increase the pulse rate. Alternatively a mechanical pulsing arrangement may be employed, acting through the intermediary of another fluid. (UK)

25275 SEMIRANIS: SPECIALIZED EXAMINATION OF RADIOACTIVE MATERIALS. Bazin, J.; Chignon, J.; Perrot, M.; Rousset, P. (CEN de Saclay, Gif-sur-Yvette, France). Bull. Inform. Sci. Tech. (Paris); No. 174, 29-37(Oct 1972). (In French).

The SEMIRAMIS examination line consists of a sample preparation cell, a shielded electron microprobe, an x-ray diffractometer, and a thermal conductivity measurement cell. (FR)

25276 TRANSFER CARRIAGE. Brisac, M.; Comche, F.; Naujalis, P. (to Commissariat a l'Energie Atomique). French Patent 2,123,059. 8 Sep 1972. Filed date 19 Oct 1970. 15p. (In French).

A transfer carriage for the remote controlled transport of a receptacle between various different positions is presented. Particular attention is given to a system having a receptacle transporting radioactive objects or materials. (FR)

Transportation

25277 (DP-1292) DRUM AND BOARD-TYPE INSULATION OVERPACKS OF SHIPPING PACKAGES FOR RADIOACTIVE MATERIALS. Lewallen, E. E. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.). Jul 1972. Contract AT(07-2)-1. 58p. Dep. NTIS $3.00.

Seven different shipping packages for radioactive materials were developed at the Savannah River Plant. The packages have Celotex overpacks for heat and impact protection and Military Standard drums for outer containers. In development tests, twenty prototype packages were dropped 30 ft, and eight packages were heated to 1475°F in a furnace. Military Standard drums were specified for outer containers of all packages because of the strength and close tolerances of these drums. Special torquing procedures were required and cover gaskets were omitted to assure strong closures. Clearances between the insulation, drum, and inner container were minimized to constrain the insulation during impact. Because Celotex is combustible and evolves gases when heated, drums were vented to avoid rupture. Cera Form, a refractory insulation material was placed adjacent to the vents to retard air flow into the drum and prevent smoldering of Celotex. Cerafelt, a more-flexible refractory material, was placed between the drum cover and Celotex to serve as a spacer and to prevent combustion if the cover is ruptured. Because Celotex degrades mechanically during long exposure to high temperature (above 250°F), the internal temperature from decay heat must be limited. Alternative materials for Celotex were studied. Fesco and Firedike were found suitable substitutes for Celotex. Specifications for drum-type insulation overpacks are presented as an Appendix. (auth)

25278 PAST EXPERIENCE AND FUTURE TRENDS IN TRANSPORTATION OF SPENT NUCLEAR FUEL. Dufrane, K. H. (Nuclear Fuel Services, Inc., West Valley, NY). Proc. Amer. Power Conf.; 34: 188-194(1972).

From 34th annual meeting of the American power conference; Chicago, Illinois, USA (18 Apr 1972).

See CONF-720465-.

The transport of spent fuels from the reactor plant to the fuel reprocessing plant is discussed. Information is included on cask design, quantities of spent fuel requiring shipment by 1980, experience since 1966 at Nuclear Fuels Services, Inc., in handling spent fuel shipments, the development of new cask designs based on this experience, and future trends in the rail and truck transport of spent fuel. (LCL)

25279 TRANSPORT OF DANGEROUS GOODS BY ROAD. Mayer, H. (Technischer Ueberwachungs-Verein Bayern eV, Munich). Mod. Unfallverhuet.; No. 16, 112-118(1972). (In German).

A survey of currently applied regulations is presented and regulations likely to be introduced in the near future are discussed. It is referred to international, as well as national regulations, e.g., those governing the safe transport of dangerous goods by road, licenses for frontier traffic, and applications for granting of the license. The national regulations include, among others, a regulation concerning the prevention of damage. (GF)

25280 PACKAGING FOR THE TRANSPORT AND STORAGE OF RADIOACTIVE MATERIALS. Blum, P. (to Transnucleaire, Societe pour les Transports de l'Industrie Nucleaire). French Patent 2,113,805. 30 Jun 1972. Filed date 17 Nov 1970. 18p. (In French).

Packaging for the storage and transport of radioactive materials (spent fuel elements) that is easily constructed from demountable and replaceable elements is described. It is in the form of an inner vessel or capsule capable of being closed tight, and containing a coolant fluid. The radioactive materials are contained in the inner vessel. A γ ray shielding (made of Pb or U clad with stainless steel) surrounds the side wall of the inner vessels, the protection against γ radiation being also envisaged at the lid and base of the inner vessel. An outer vessel or shell having good mechanical stress resistance properties surrounds this inner vessel. This external vessel is provided with cooling elements in its side walls and is filled with water. The assembly (capsule and γ ray shielding) is immersed in this outer vessel. The sizes of the different elements of the packaging are such that the thickness of the layer of water between the γ ray shielding and the outer vessel is sufficient to ensure protection against the neutrons emitted. (FR)

PARTICLE ACCELERATORS

Design, Development, and Operation

Refer also to abstracts 24306, 26139, 26154, 26169, and 26189.

25281 (BNL-17707) PERFORMANCE REPORT ON THE POST CONVERSION AGS. Barton, M.; Batchelor, K.; Blumberg, L.; Cottingham, J.; Glenn, J.; Grisoli, J.; Herrera, J.; Maschke, A.; Raka, E.; van Steenbergen, A. (Brookhaven National Lab., Upton, N. Y.). 1972. 5p. (CONF-730310-19). Dep. NTIS $3.00.

From fifth Particle accelerator conference; San Francisco, California, USA (5 Mar 1973).

The present AGS status and recent performance results are described and details are given regarding the 200-MeV linac injector, multiturn injection, orbit improvements, intensity limitations and logitudinal effects, the bunched fast extraction, the "shaving" mode of fast extraction and the slow external beam switchyard development. (auth)

25282 CONSTRUCTION OF LARGE ACCELERATORS: SCIENTIFIC AND POLITICAL ASPECTS. Heisenberg, W. (Max Planck Inst. for Physics and Astrophysics, Munich). Science; 179: No. 4074, 643-647(16 Feb 1973).

Topics include progress through large accelerators, factors involved in building larger accelerators, attitudes and influence of scientists, cooperation of European states, obsolescence in physics, and motives behind the building of giant accelerators. (WHK)

25283 PROTON ACCELERATION IN A SUPERCONDUCTING LINAC. Kuntze, M. (Kernforschungszentrum, Karlsruhe, Ger.). KFK Nachr.; 4: No. 3, 1-4(1972). (In German).

The experience gained during the construction and operation of the first test stage of a superconducting proton linear accelerator is summarized. This test stage consists of a cryostat measuring 4 m in length, the first superconducting accelerating unit, a superconducting quadrupole lens for beam focusing, and a number of accelerator mockups. The results of the first acceleration experiments are given as well. (GF)

25284 HEAVY ION BEAMS IN BIOLOGY, MEDICINE, AND CHEMISTRY. Keller, C. (Kernforschungszentrum, Karlsruhe, Ger.). Naturwiss. Rundsch.; 25: No. 8, 308-309(1972). (In German).

The main activities of the research centers concerned with heavy ions such as the Lawrence Radiation Laboratory with the BEVATRON which yields 36 GeV nitrogen-14 ions and the HILAC, presently in the process of construction, are summarized. Two cyclotrons are available in Dubna/USSR, and the ALICE linear accelerator in Orsay can also be used to accelerate heavy ions. One of the main activities in the field of heavy ion research is the production of superheavy nuclei. Another field of application in biology and medicine is cancer research and therapy. (GF)

25285 APPARATUSES FOR TRAPPING AND ACCELERATING NEUTRAL PARTICLES. Ashkin, A. (to Bell Telephone Labs., Inc.). U. S. Patent 3,710,279. 9 Jan 1973. Filed date 15 Dec 1969. 20p.

There is disclosed a variety of apparatuses for controlling by radiation pressure the motion of a particle free to move with respect to its environment, based on the discovery that one or more beams of optical radiation can have frequency, diverging shape or intensity selected for a controlled radiation-pressure interaction with the particle that overpowers gravity and collision effects of atoms and molecules and overpowers any photophoresis interaction of the particle and its environment due to a heating effect of said particle upon its environment. The disclosed results of the effect of the radiation pressure on the motion of the particle include controllably heating the particle to provide a black-body point light source, bombardment of a sample target with such particles, very high energy particle acceleration, strong-focusing acceleration of a neutral particle, isotope separation, gas pumping, separation of particles by size, population inversion based on radiation-pressure separation of excited species, vacuum deposition of thin films from ultrapure particles controllably vaporized while held by radiation pressure, tensile-strength testing of materials based on the radiation-pressure effect of circularly polarized light, contaminant-free trapping or bottling of neutral gases, molecular beam separation and deflection, acceleration measurement for inertial guidance and measurement of very low gas pressures. (Official Gazette)

25286 MEASUREMENTS OF INDUCED RADIOACTIVITY IN DUST AROUND A 400 MeV LINAC. Lucci, F.; Merolli, S.; Pelliccioni, M. (Comitato Nazionale per l'Energia Nuclear, Frascati, Italy). Health Phys.; 24: No. 4, 411-415(Apr 1973).

Some measurements of induced radioactivity in dust around a 400 MeV linear electron accelerator have been carried out. The main radionuclides found in smear test samples concerning the final part of the accelerator are ^{39}Cl, ^{38}Cl and β^+ emitters with a short half-life; ^{54}Mn was also detected. During a long maintenance work dust samples of about 10 g were collected and analyzed. Many radionuclides were found and particularly ^{54}Mn, ^{7}Be, ^{65}Zn and some cobalt isotopes. Internal contamination problems around high energy accelerators do not seem particularly serious, but, at least for rather powerful accelerators, they should be given closer attention than that received up to now. (auth)

25287 HEAVY-ION ACCELERATORS OF THE FUTURE. Schmelzer, C. (Univ., Heidelberg). J. Phys. (Paris), Colloq.; No. 5, C5.195-C5.206(1972).

The properties required of beams for heavy ions nuclear research purposes are presented. Currently available techniques using existing accelerators are described. Future developments envisaged, new ion sources, superconducting accelerators, and collective acceleration (electron rings) are discussed. (FR)

25288 CYCLOTRONS-1972. Sixth International Cyclotron Conference, Vancouver, Canada, July 18-21, 1972. Burgerjon, J. J.; Strathdee, A. (eds.). AIP conference proceedings, Number 9. New York; American Institute of Physics (1972). 850p. (CONF-720717-).

From 6th international cyclotron conference; Vancouver, B. C. (18 Jul 1972).

A separate abstract was prepared for each of the 74 papers presented at the conference and the appendix. (WHK)

For abstracts of individual papers see: 24306, 24927, 25289-25323, 25338-25355, 25368-25375, 25381-25389, and 25411-25413.

25289 CURRENT STATUS OF THE INDIANA UNIVERSITY CYCLOTRON FACILITY. Rickey, M. E. (Indiana Univ., Bloomington). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 9, 1-15(1972).

From sixth international cyclotron conference; Vancouver, B. C. (18 Jul 1972).

See CONF-720717-.

Recent progress and the present status of the multi-stage Indiana University Cyclotron Facility are described. Some of the problems which have been encountered and their consequences and solutions are discussed. Emphasis has been placed on work which has proceeded since the 1969 International Cyclotron Conference in Oxford. (auth)

25290 FUTURE CYCLOTRONS. Blosser, H. G. (Michigan State Univ., East Lansing). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 9, 16-32(1972).

From sixth international cyclotron conference; Vancouver, B. C. (18 Jul 1972).

See CONF-720717-.

Future trends in cyclotron design are reviewed, first briefly from the point-of-view of cyclotrons now in construction and second from the point-of-view of design features. The topics covered include the choice of a conventional or separated-sector magnet, the use of dees or cavities for acceleration, possible flat-topping of the rf wave, the impact of new technologies on design and operation, and extensions of the cyclotron concept to higher energies. (auth)

25291 ALTERNATES TO THE CYCLOTRON FOR HEAVY-ION ACCELERATION. Martin, J. A. (Oak Ridge National Lab., TN). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 9, 33-53(1972).

From sixth international cyclotron conference; Vancouver, B. C. (18 Jul 1972).

See CONF-720717-.

The status and future possibilities for several alternates to the cyclotron for heavy-ion acceleration are discussed. Linear accelerators, both conventional and superconducting, tandem electrostatic accelerators, and the electron ring accelerator are among the accelerator types and concepts reviewed and compared. (auth)

25292 PROPOSED NATIONAL HEAVY-ION ACCELERATOR AT OAK RIDGE. Martin, J. A.; Hudson, E. D.; Lord, R. S.; Mallory, M. L.; Milner, W. T.; Mosko, S. W.; Stelson, P. H. (Oak Ridge National Lab., TN). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 9, 54-62(1972).

From sixth international cyclotron conference; Vancouver, B. C. (18 Jul 1972).

See CONF-720717-.

The proposed National Heavy-ion Laboratory will be provided with a multi-stage accelerator system integrated with the existing Oak Ridge Isochronous Cyclotron (ORIC) facilities. The main accelerator stage is to be a four-sector isochronous cyclotron that will provide beam energies up to 100 MeV/u. Ions may be injected into the large cyclotron from either a 20 MV tandem electrostatic accelerator or from the ORIC. The ion energies range from 100 MeV/u for oxygen to 10 MeV/u for uranium. Maximum beam intensities range from $\sim 10^{13}$ particles/second for oxygen to 2×10^{12} particles/second for uranium. The sector magnet angle for the cyclotron is 52° which yields radial and axial focusing frequencies of $\nu_r = 1.1$ to 1.2 and $\nu_z = 0.6$ to 0.8. The field-radius product of the magnet is 3018 kG-cm at a maximum magnetic field of 16 kG. The rf system is tunable over the range 6 to 14 MHz to accommodate acceleration on harmonics 2 to 11. Second harmonic resonators are provided to increase the phase acceptance and/or the energy resolution. (auth)

25293 COMBINATION OF A VAN DE GRAAFF ACCELERATOR AND A SPLIT-POLE CYCLOTRON FOR HEAVY IONS. Efken, B. (Hahn-Meitner-Institut fuer Kernforschung, Berlin); Hilscher D.; Homeyer, H.; Jahnke, U.; Lindenberger, K. H.; Mahnke, H. E.; Maier, K. H.; Scheer, J. A.; Holm, S. AIP (Amer. Inst. Phys.) Conf. Proc.; No. 9, 63-68(1972).

From sixth international cyclotron conference; Vancouver, B. C. (18 Jul 1972).

See CONF-720717-.

The proposed accelerator system consists of a HVEC model CN Van de Graaff as injector and a split-pole-cyclotron. This combination is able to accelerate ions of mass $A \leq 40$ up to an energy of 200 MeV. Beam currents of 10^{12} particles/s at an energy resolution of $\Delta E/E = 10^{-3}$ are anticipated. The Van de Graaff accelerates doubly charged ions to $E_i \leq 12$ MeV. The ions are stripped and further accelerated in the cyclotron to $16.8 \cdot E_i$. The cyclotron consists of 4 separated 50° magnets and two 36° dees. The energy capability of the magnet is $A \cdot E/q^2 = 100$ MeV. (auth)

25294 MAGNETIC FIELD PROPERTIES OF THE INDIANA ISOCHRONOUS CYCLOTRONS. Pollock, R. E. (Indiana Univ., Bloomington). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 9, 69-77(1972).

From 6th international cyclotron conference; Vancouver, B. C. (18 Jul 1972).

See CONF-720717-.

Some of the measured properties of magnetic fields for the injector stage and final stage cyclotrons under construction at Indiana University are described. The simple geometry and the operation at moderate field strength lead one to expect a predictable magnetic field. A discussion of observed departures from the predicted properties is presented. Data include selected radial and azimuthal profiles as a function of main field excitation; reproducibility from sector to sector and with hysteresis; properties and requirements of current sheet trim coils; and miscellaneous topics. (auth)

25295 DESIGN STUDY FOR A COMPACT 200 MeV CYCLOTRON. Gordon, M. M.; Blosser, H. G.; Johnson, D. A. (Michigan State Univ., East Lansing). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 9, 78-86(1972).

From 6th international cyclotron conference; Vancouver, B. C. (18 Jul 1972).

See CONF-720717-.

A preliminary study has been carried out for a variable energy, 200-MeV cyclotron which is designed for both nuclear physics and medical research. The operational and structural features of this machine are modeled closely on the Michigan 50 MeV cyclotron. The magnet would have the same gap, but twice the diameter (3 m) and twice the number of trim coils (17), and it would have four (instead of three) sectors with sufficient additional spiral. The rf system would operate in the 10 to 20 MHz range, with two 90° dees carrying up to 70 kV. This cyclotron would produce protons at energies up to 200 MeV, and other ions to corresponding energies. By extending present phase selection and single turn extraction techniques to this cyclotron, the energy resolution of the extracted beam would be: $E/(\Delta E) = 7000$. With proton currents of about 2 μA, the beam emittances would be 0.3 mm-mrad radially and 2.5 mm-mrad axially. The estimated cost of the cyclotron itself would be around two million dollars. (auth)

25296 KIEV 240-cm ISOCHRONOUS CYCLOTRON. Kolotii, V. V. (Nuclear Research Inst., Kiev); Linev, A. F.; Malofeev, A. I.; Pasechnik, M. V.; Pashin, V. A.; Saenko, V. A.; Basargin, Yu. G.; Fedorov, A. S.; Glukhikh, V. A.; Gusev, O. A.; Komar, E. G.; Litunovskii, R. N.; Malishev, I. F.; Minyaev, O. A.; Rozhdestvenskii, B. V.; Stepanov, A. V. AIP (Amer. Inst. Phys.) Conf. Proc.; No. 9, 87-94(1972).

From 6th international cyclotron conference; Vancouver, B. C. (18 Jul 1972).

See CONF-720717-.

At the Nuclear Research Institute of Ukrainian Academy of Sciences in Kiev, the construction of a 240-cm isochronous cyclotron is being accomplished. The accelerator design was developed by the D. V. Efremov Scientific Research Institute of Electrophysical Apparatus in Leningrad, and is in the state of assembly and adjustment. The cyclotron provides for variable-energy protons up to 80 MeV of high beam quality as well as neutron pulses with durations less than two ns at pulse rates from 1 to 100 kHz. It may also be used for accelerating heavy ions. The main data concerning the cyclotron and its main mode of operation are described. (auth)

25297 103-cm COMPACT ISOCHRONOUS CYCLOTRON. Basargin, Yu. G.; Bogdanov, P. V.; Finkelshtein, I. I.; Galaev, A. N.; Galchuk, A. V.; Glukhikh, V. A.; Gusev, O. A.; Malishev, I. F.; Popov, A. V.; Stepanov, A. V.; Stogov, Yu. I. (Scientific-Research Inst. of Electrophysical Apparatus, Leningrad). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 9, 102-106(1972).

From 6th international cyclotron conference; Vancouver, B. C. (18 Jul 1972).

See CONF-720717-.

The description of a compact variable-energy isochronous cyclotron is given. The manufacturing of the main units of the prototype of the accelerator has been accomplished in the D. V. Efremov Scientific Research Institute of Electrophysical Apparatus (SRIEA). The cyclotron is intended for acceleration of protons, ions of deuterium, helium-3, and helium-4 and can be used for production of radioisotopes, activation analysis and for investigations in the fields of medicine, biology, and nuclear physics. (auth)

25298 STATUS REPORT ON THE VARIABLE ENERGY CYCLOTRON AT CALCUTTA. Kundu, D. N. (Saha Inst. of Nuclear Physics, Calcutta). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 9, 107-109(1972).

From 6th international cyclotron conference; Vancouver, B. C. (18 Jul 1972).

See CONF-720717-.

For the variable energy cyclotron under construction at Calcutta, the design features of the Berkeley 88-inch cyclotron, as slightly modified in the similar A & M Texas machine, have been adopted. The construction is a Bhabha Atomic Research Center project under the Department of Atomic Energy, Government of India, and is taking place in an area of 28 acres of land jointly with the development and expansion program of the Saha Institute of Nuclear Physics. The relevant machine specifications have been incorporated in the ORNL compilation "Cyclotrons–1972, AVF and FM." Two major changes in this machine are that (1) the magnet yoke pieces are of cast steel and (2) the trim and valley coils are epoxy potted and not mineral insulated. The progress of fabrication and testing for different items is briefly given. (auth)

25299 STATUS REPORT ON THE CATHOLIC UNIVERSITY OF LOUVAIN CYCLOTRON. Jongen, Y. (Catholic Univ., Louvain, Belgium); Macq, P.; Delphin, P.; Dupuis, A.; Hurt, B.; Marniquet, L.; Peironet, P. AIP (Amer. Inst. Phys.) Conf. Proc.; No. 9, 110-113(1972).

From 6th international cyclotron conference; Vancouver, B. C. (18 Jul 1972).

See CONF-720717-.

The 80 MeV (protons) cyclotron built for the University of Louvain is described. The machine features variable energy and can also accelerate deuterons, ^{3}He and alpha particles. Design and construction were completed within 40 months and first operational results are reported. (auth)

25300 STATUS REPORT ON THE SIN RING CYCLOTRON. Willax, H. A. (Swiss Inst. for Nuclear Research, Villigen). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 9, 114-125(1972).

From 6th international cyclotron conference; Vancouver, B. C. (18 Jul 1972).

See CONF-720717-.

For the production of intensive meson beams, a ring cyclotron for a 100 μA proton beam at 590 MeV is presently being constructed at the Swiss Institute for Nuclear Research (SIN) near Villigen, in the northern part of Switzerland. The pre-acceleration of the beam to 72 MeV will be accomplished by an AVF-cyclotron, which can also be used for acceleration of d, He, and heavy ions to variable

energies. The status of the development and construction of the ring cyclotron is described. (auth)

25301 PRESENT STATUS OF TRIUMF. Richardson, J. R. (TRIUMF, Vancouver, B. C.). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 9, 126-140(1972).

From 6th international cyclotron conference; Vancouver, B. C. (18 Jul 1972).

See CONF-720717-.

The current status of the TRIUMF project is described. Erection of the cyclotron magnet is virtually complete, including the support structure which raises and lowers the upper half of the magnet. The vacuum chamber has been tested, with cryopumping enabling a pressure of 10^{-7} torr to be achieved within a few hours. The final design pressure of 4×10^{-8} torr looks easily achievable. The resonators, operating on the fifth harmonic of the ion frequency, are undergoing manufacture. The radio-frequency amplifiers have been tested and appear to be capable of delivering the 1600 kW of 23 MHz power required for operation at 200 kV between the dees. The initial version of the ion source and injection system has been tested and the H^- beam has been injected into the full-scale model of the central region of the cyclotron. (auth)

25302 STATUS OF THE CERN SYNCHROCYCLOTRON IMPROVEMENT PROGRAMME AND PLANS FOR PHYSICS FACILITIES. Michaelis, E. G. (CERN, Geneva). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 9, 141-164(1972).

From 6th international cyclotron conference; Vancouver, B. C. (18 Jul 1972).

See CONF-720717-.

The present status of the CERN SC Improvement Program is summarized. Details are given of the design and performance of some components incorporating novel features. The beam facilities planned for future physics research are described. (auth)

25303 STATUS OF THE NEVIS SYNCHROCYCLOTRON MODIFICATION. Rainwater, J. (Columbia Univ., New York). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 9, 165-178(1972).

From 6th international cyclotron conference; Vancouver, B. C. (18 Jul 1972).

See CONF-720717-.

The Columbia University Nevis Synchrocyclotron modification should give ~20 μA (time average) of 560 to 570 MeV protons in an external beam of ≥50% duty factor at a 300 Hz rep. rate. A 3-fold symmetry azimuthally varying field is used. The final 360° and sector iron shimming touchup is now completed. Orbit studies show proton orbit stability for acceleration and extraction. About 80% extraction efficiency is indicated. Dee and ground skin installation is nearly complete. Rf operation, internal beam, and extraction studies are expected to be followed by operation for experiments by late 1972 or early 1973. No fundamental problems with the systems have developed. External Be targets are used for π and μ beam production, with three secondary charged particle beam lines. Pulsed neutron t.o.f. spectroscopy is also permitted. (auth)

25304 STATUS REPORT ON THE 680 MeV DUBNA SYNCHROCYCLOTRON RECONSTRUCTION. Denisov, Yu. N. (Joint Inst. for Nuclear Research, Dubna, USSR). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 9, 179-190(1972).

From 6th international cyclotron conference; Vancouver, B. C. (18 Jul 1972).

See CONF-720717-.

A review of the current state of modification of the operating 680 MeV JINR synchrocyclotron into the high intensity phasotron is presented. (auth)

25305 ACCELERATION OF Xe IONS IN THE JINR TANDEM CYCLOTRONS. Shelaev, I. A.; Alfeev, V. S.; Zager, B. A.; Kozlov, S. I.; Kolesov, I. V.; Mel'nikov, V. N.; Oganesyan, R. Ts.; Filipson, A. N.; Chugreev, V. A. (Joint Inst. for Nuclear Research, Dubna, USSR). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 9, 232-242(1972).

From 6th international cyclotron conference; Vancouver, B. C. (18 Jul 1972).

See CONF-720717-.

An accelerating system consisting of a 310-cm and a 2-m cyclotron is described for accelerating Xe ions to about 7 MeV/nucl at an intensity of 2×10^{10} part/s. (auth)

25306 RESULTS OBTAINED FROM ALICE AND FUTURE PROSPECTS. Baron, E.; Bieth, C.; Bourgarel, M. P.; Cabrespine, A.; Goldstein, C.; Junquera, T. (Institut de Physique Nucleaire, Orsay, France). AIP (Amer. Inst. Phys.).Conf. Proc.; No. 9, 243-257(1972).

From 6th international cyclotron conference; Vancouver, B. C. (18 Jul 1972).

See CONF-720717-.

An accelerator for 75 $(Q/A)^2$ MeV/amu heavy ion beams with ability to produce by stripping a rather large Q/A ratio—at least 0.285 in the 40 to 80 mass range—is now in operation in Orsay. As previously described, ALICE consists of a Linac ($Q/A \geq 0.08$) acting as an injector at 1.15 MeV/amu and a sector-focused isochronous cyclotron. 505 MeV Kr^{24+}, 475 MeV Kr^{23+} (10^{-10} to 2×10^{-10} A particle current) and 227 MeV Ar^{11+}, 300 MeV Ar^{13+} (4×10^{-9} to 8×10^{-9} A particle current) are the most used beams since 1971, with an operation time of about 70%. Different improvements of the conceptual design have been needed to obtain these results, the principal one being on the platform where the PIG ion source has been put in an analyzing magnet (5 kG) with an improved vacuum (10^{-6} torr). The efficiency of the main components is discussed, and some future improvements are proposed. With a view to satisfying an increasing demand, a new beam transport system has been designed (9 lines) and its installation is planned for December 1972. Some ideas about the prospects of the machine, in view of increasing its ability to accelerate heavier ions, are briefly exposed. (auth)

25307 HEAVY ION ACCELERATION AT THE BERKELEY 88-INCH CYCLOTRON. Clark, D. J.; Steyaert, J.; Bowen, J.; Carneiro, A.; Morris, D. (Univ. of California, Berkeley). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 9, 265-273(1972).

From 6th international cyclotron conference; Vancouver, B. C. (18 Jul 1972).

See CONF-720717-.

A new internal heavy ion source of the Penning type has been in operation at the Berkeley 88-Inch Cyclotron for 10 months. Beams of lithium, carbon, nitrogen, oxygen, neon, and iron have been accelerated and used in experiments in the energy range 4 to 18 MeV/nucleon. External beam intensities are 1 to 10 μA of most carbon, nitrogen, and oxygen beams. Many experiments have used the new high-resolution reaction product magnetic spectrometer and resistive wire focal plane detector. (auth)

25308 ORIC AS A HEAVY-ION INJECTOR FOR A SEPARATED SECTOR CYCLOTRON. Hudson, E. D.; Lord, R. S.; Mallory, M. L.; Stelson, P. H. (Oak Ridge National Lab., TN). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 9, 274-282(1972).

From 6th international cyclotron conference; Vancouver, B. C. (18 Jul 1972).

See CONF-720717-.

The characteristics of the Oak Ridge Isochronous Cyclotron (ORIC) for the injection of heavy-ions into a separated sector cyclotron have been studied and found to be excellent. With a carbon foil between the accelerators the output energy of the ORIC is sufficient to give a stripped ion beam at least twice the charge state of the ORIC's extracted beam up to mass 200. This allows an ideal magnetic field match to a separated sector cyclotron with a magnet fraction of 0.58. The 37-MeV $^{40}Ar^{4+}$ beam from the ORIC was used to test the lifetime of 20-$\mu g/cm^2$ carbon foils. It was found that the stripping characteristics were unchanged after a total transmission of 5×10^{17} particles per cm^2. Results of the measurement of the ORIC beam loss as a function of pressure in the cyclotron tank and beam line are also presented. (auth)

25309 VARIABLE FREQUENCY LINAC AND ITS USE AS AN INJECTOR FOR A SEPARATE SECTOR HEAVY ION CYCLOTRON. Odera, M.; Tonuma, T. (Inst. of Physical and Chemical Research, Saitama, Japan). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 9, 283-290(1972).

From 6th international cyclotron conference; Vancouver, B. C. (18 Jul 1972).

See CONF-720717-.

Design of a variable frequency π-mode linac and its use as a prestripper accelerator for a separate sector cyclotron are described. Acceleration of ions of almost all of the elements is possible with moderate intensity. A wide range of difference in charge-to-mass ratio can be handled with frequency variation proportional to $(q/m)^{\frac{1}{2}}$. Variable energy operation is also feasible. A two-stage accelerator combined with a separate sector cyclotron is proposed. With deliberate design the system can be a versatile heavy ion accelerator. Use of the separate sector cyclotron as a post-stripper accelerator has several advantages which are elucidated. (auth)

25310 ACCELERATING SYSTEM OF ISOCHRONOUS CYCLOTRON WITH A NON-SINUSOIDAL ELECTRIC FIELD. Kuzmiak, M. (Inst. of Nuclear Physics, Rez, Czech.); Hrda, A.; Bejsovec, V.; Krivanek, M.; Trejbal, Z.; Kolga, V. V. AIP (Amer. Inst. Phys.) Conf. Proc.; No. 9, 308-314(1972).

From 6th international cyclotron conference; Vancouver, B. C. (18 Jul 1972).

See CONF-720717-.

A non-sinusoidal accelerating voltage was considered which may be formed with a dee system consisting of two dees. The fundamental harmonic voltage is applied to the first dee and the third harmonic is fed to the other dee. It has been found by the study of the ion motion in the cyclotron median plane that there exists a correlation between the growth of radial oscillation amplitude and the azimuthal distribution of accelerating gaps. A criterion has been formulated for eliminating the growth of amplitude of radial oscillations due to electric field. (auth)

25311 OPTIMIZATION OF THE PHASE ACCEPTANCE OF THE TRIUMF CYCLOTRON. Dutto, G. (TRIUMF, Vancouver, B. C.); Kost, C.; Mackenzie, G. H.; Craddock, M. K. AIP (Amer. Inst. Phys.) Conf. Proc.; No. 9, 340-350(1972).

From 6th international cyclotron conference; Vancouver, B. C. (18 Jul 1972).

See CONF-720717-.

The horizontal and vertical beam behavior in the TRIUMF cyclotron has been calculated numerically up to 20 MeV. Effects limiting the cyclotron phase acceptance for an extracted beam with good emittance and energy resolution are discussed, as well as ways of overcoming these effects. Two effects which are critical because of their strong phase dependence are vertical electric focusing at the dee gaps and coupling between the radial and longitudinal motions. With only the RF fundamental present it is shown that the second of these effects can be reduced considerably by the use of local bumps in either the average magnetic field or its second harmonic component, or both. The addition of a third harmonic RF component suitably phase shifted from the fundamental results in the phase dependence of both effects being considerably reduced over a wide phase range. For an initial beam emittance of 0.5 π in.-mrad and an extracted energy resolution of ±600 keV the net phase acceptance is expected to be ~30° with fundamental RF only and ~60° with 24% third harmonic RF added leading 8° in phase. (auth)

25312 MODIFICATIONS TO THE UNIVERSITY OF MICHIGAN 83-INCH CYCLOTRON TO IMPROVE BEAM QUALITY. Parkinson, W. C.; Gray, W. S.; Petersen, J. F.; Day, R. H. (Univ. of Michigan, Ann Arbor). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 9, 366-373(1972).

From 6th international cyclotron conference; Vancouver, B. C. (18 Jul 1972).

See CONF-720717-.

Recent studies of the internal and extracted beams at the higher energies (up to 40-MeV deuterons and 80-MeV α-particles) led to the conversion of the dee system of the 83-inch cyclotron from two 150° dees to one 180° dee. The primary purpose was to remove from the deflector channel the rf dee voltage, which because of its phase opposes the dc deflector voltage and in addition introduces an energy spread in the extracted beam. The one-dee system offers further advantages. The equivalent first harmonic due to a gap-crossing driving force which is a function of the dee geometry and dee voltage balance in the two-dee system, is essentially eliminated, and control of the central orbits, in particular the selection of phase width, is facilitated. The measured values of the beam quality and energy spread are in good agreement with calculations. These results, together with the diagnostic instrumentation used in obtaining them, are described. (auth)

25313 MEDICAL USES OF THE HARVARD UNIVERSITY CYCLOTRON. An Overall View. Wilson, R. (Harvard Univ., Cambridge, MA). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 9, 578-585(1972).

From 6th international cyclotron conference; Vancouver, B. C. (18 Jul 1972).

See CONF-720717-.

The Harvard Cyclotron has been used for medical work since 1961 and has been maintained primarily for this purpose since 1968. The potential advantages of therapy with protons were pointed out in 1947 but, until recently, contact between physicists and doctors has been insufficient to enable rapid development of this technique. So far the work at Harvard has been with small non-proliferating tumors, but we expect to extend this to large proliferation tumors. Proton radiography is being developed at Harvard and its uses in diagnosis are beginning to receive attention from the medical profession. Finally, we are studying the possibilities of measuring calcium content of bone by proton bombardment. (auth)

25314 MEDICAL TREATMENT AND DIAGNOSIS USING 160 MeV PROTONS. Koehler, A. M. (Harvard Univ., Cambridge, MA). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 9, 586-602(1972).

From 6th international cyclotron conference; Vancouver, B. C. (18 Jul 1972).

See CONF-720717-.

The 160 MeV proton synchrocyclotron at Harvard University, abandoned for nuclear physics research in 1967, has been operating for 4.5 years on a part-time basis for the treatment of patients and for other investigations, several of which are medically oriented. The cost of operation is met entirely from users' fees of about $1200 per 24-hour day. In the current clinical program, initiated in 1961, the pituitary gland is the usual target and some 540 patients have been treated, the current case load being 55 to 60 new patients per year. The proton beam also offers advantages in terms of physical dose distribution for larger targets more typical of cancer therapy. Apparatus is being modified to test these advantages experimentally with the expectation that limited clinical trials might be undertaken later. The use of protons for diagnostic purposes is also being investigated. Proton radiography shows some promise in visualizing soft tissue structures and abnormalities. Tumors, cerebral infarctions, hemorrhages and aneurisms have been visualized in brain specimens. In the human breast, malignant carcinoma has shown useful contrast. Clinical value of the technique remains to be explored. As medical applications of protons in the 150 to 200 MeV energy range become better understood, the question arises whether a suitable accelerator could be designed within the budget, staff and space limitations of major cancer treatment centers. A synchrocyclotron design concept is proposed which might prove suitable. (auth)

25315 DESIGN STUDIES FOR A 200 MeV PROTON CLINIC FOR RADIOTHERAPY. Graffman, S.; Jung, B.; Larsson, B. (Univ. of Uppsala). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 9, 603-615(1972).

From 6th international cyclotron conference; Vancouver, B. C. (18 Jul 1972).

See CONF-720717-.

In Sweden (8 million inhabitants), there is demand for about 1000 radiotherapy treatments per day. About one-quarter of these would benefit from the outstanding dose distributions attainable with protons. Five treatment rooms are required for 220 treatments per day—providing vertical, horizontal and angled beams. Separate facilities are provided for radiosurgery and radionuclide production. The beam cross-section should be up to 30 × 30 cm, intensity uniform within ±2% over the treatment volume, length of the plateau region variable from 2 to 27 cm and dose rate at least 200 rad/min. The operating reliability of the system must be extremely high. The medical requirements can be met with a fixed-energy isochronous cyclotron with a beam transport system incorporating an eight-channel beam distributor, bending and focusing magnets, and beam sweeping magnets. The cost of the whole system, including building, all accessories and a radionuclide production facility but excluding wards and normal clinical laboratories, was estimated at US $7 million. (auth)

25316 COMPACT CYCLOTRON ENGINEERING FOR APPLICATION. Hendry, G. O. (Cyclotron Corp., Berkeley, CA). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 9, 616-626(1972).

From 6th international cyclotron conference; Vancouver, B. C. (18 Jul 1972).

See CONF-720717-.

Some current uses of compact cyclotrons in the fields of physics, nuclear medicine, and neutron therapy are considered. The principle cyclotron performance characteristics required by each of these applications are discussed and design innovations introduced to meet these requirements presented. (auth)

25317 ARGONNE CANCER RESEARCH HOSPITAL CYCLOTRON. Harper, P. V.; Skaggs, L. S.; Porter, J.; Lembares, N.; Forsthoff, H.; Krizek, H.; Lathrop, K. A.; Kuchnir, F. (Argonne Cancer Hospital, Chicago). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 9, 627-637(1972).

From 6th international cyclotron conference; Vancouver, B. C. (18 Jul 1972).

See CONF-720717-.

The installation of a cyclotron (Cyclotron Corp. CS-15) in an existing building without disruption of other operations was accomplished with relatively little difficulty using overdesigned shielding (6 feet of ordinary concrete). Background measurements on a whole-body counter 50 feet away on the same floor were increased only 10% summing over the whole spectrum. Available space in the vault is 18 × 13 feet, permitting convenient operation of a 3-port target facility oriented vertically. The operating responsibility has been entirely in the hands of personnel without previous experience, with engineering and physics back-up when needed for repairs, maintenance and improvement of the machine. The targetry has been handled almost entirely by the operating staff. During the first three years of operation, down time has been insignificant (~10%), almost equally divided between component failure and operator error. Applications have been in the production of radionuclides for experimental and clinical use.

^{66}Ga and ^{67}Ga were produced by proton and deuteron bombardment of zinc using an internal target. ^{18}F was produced using the $^{20}Ne(d,\alpha)^{18}F$ reaction which proved to be substantially more efficient than the alternative $^{16}O(^{3}He,p)^{18}F$ reaction. ^{13}N and $^{13}NH_3$ was produced by deuteron bombardment of methane as described by Tilbury at Sloan–Kettering. This material has been most useful for imaging the myocardium. ^{111}In, ^{11}C, and ^{15}O are also in production, as well as a number of other nuclides. The possibility of using the deuteron reaction (8 MeV) on beryllium to produce fast neutrons for therapy is currently being explored. In the present configuration, which includes independent control of the harmonic coils, 100 to 160 μA of deuterons have been extracted for this purpose. (auth)

25318 NUCLEAR MEDICINE USES OF TRIUMF. Morrison, R. T.; Mincey, E. K. (Vancouver General Hospital, B. C.). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 9, 650-655(1972).

From 6th international cyclotron conference; Vancouver, B. C. (18 Jul 1972).

See CONF-720717-.

The operation of the TRIUMF Cyclotron affords those interested in using medically useful radioisotopes the possibility of producing neutron deficient radionuclides with the high energy proton beam and also permits the production of neutron rich radionuclides from the high neutron flux in the beam dump. The clinical use of radionuclides produced at the TRIUMF facility must be evaluated in terms of cost versus benefit. (auth)

25319 SELECTION OF THE SIZE OF A CYCLOTRON FOR MEDICAL APPLICATIONS. Chaudhri, M. A. (Univ. of Islamabad, Pakistan); Chaudhri, A. J.; Chaudhri, Q. J. AIP (Amer. Inst. Phys.) Conf. Proc.; No. 9, 656-663(1972).

From 6th international cyclotron conference; Vancouver, B. C. (18 Jul 1972).

See CONF-720717-.

The cost and usefulness relationships of cyclotrons are studied from the points of view of isotope production, charged-particle activation analysis, and production of neutrons for therapy. Thick-target yields of the isotopes produced by proton, deuteron and alpha bombardment of all the elements with Z = 20 to Z = 83 are presented as a function of the cyclotron-size and its cost. The size of a cyclotron is represented by the maximum attainable energy E, and its cost is assumed to vary as E to the power of 3/2. The mean-energies and the dose-rates, at 100 cm from the target, of neutron beams produced by the interaction of deuterons of up to 20 MeV with beryllium, deuterium and heavy-water targets have also been investigated as functions of the cyclotron-size and its cost. It is suggested that a cyclotron big enough to accelerate deuterons up to 12 to 14 MeV is of the "Optimum-size" regarding its cost and usefulness. With such a cyclotron, enough quantities of isotopes can be produced through one and two-particles-emission reactions while the undesirable contribution from the three-particles-emission reactions would be zero or negligible. Such a machine would also produce a useful neutron beam for therapy from a beryllium target while a neutron beam as good as having 10 MeV average energy and imparting up to 100 rads/min would be produced from a suitable deuterium target. (auth)

25320 APPLICATION OF CYCLOTRONS IN MATERIALS SCIENCE. Nelson, R. S. (Atomic Energy Research Establishment, Harwell, Eng.). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 9, 664-676(1972).

From 6th international cyclotron conference; Vancouver, B. C. (18 Jul 1972).

See CONF-720717-.

Particle accelerators have been used for some time in materials science to study the effects of irradiation damage and to implant impurity atoms to well defined concentrations. In the past the majority of this work has been of a fairly fundamental nature but recently important technological problems in connection with fast reactor development have been high-lighted. The use of cyclotrons to study a variety of materials problems is reviewed, and in particular the use of the Harwell Variable Energy Cyclotron to study the phenomenon of void formation in irradiated materials is discussed. How simulation experiments can help to provide an understanding of an important technological problem is illustrated, and data are provided which can be used together with that from fast neutron irradiation to select the most suitable materials for the design of fast reactors. (auth)

25321 APPLICATIONS OF ACCELERATORS IN PHYSICS AND CHEMISTRY. Cahill, T. A. (Univ. of California, Davis). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 9, 677-681(1972).

From 6th international cyclotron conference; Vancouver, B. C. (18 Jul 1972).

See CONF-720717-.

Accelerator beams are becoming increasingly used in a variety of applied fields, such as material testing, space simulation, radiodiagnostic and radiotherapeutic work, and elemental analysis. Criteria necessary to establish a viable program based upon such a technique are proposed. In light of these criteria, programs involving elemental analysis of environmental, medical and industrial samples are discussed, with special emphasis on methods for reducing the disadvantages associated with an accelerator-based technique. (auth)

25322 SOME APPLICATIONS OF THE EINDHOVEN A.V.F. CYCLOTRON. Baghuis, L. C. J.; Duys, A. W. W.; Hagedoorn, H. L.; Prins, M. (Eindhoven Univ. of Tech., Netherlands). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 9, 682-688(1972).

From 6th international cyclotron conference; Vancouver, B. C. (18 Jul 1972).

See CONF-720717-.

Short-living isotopes are produced with the cyclotron. The isotopes are injected as tracers into a discharge and will follow the flow lines. In this way the transport processes inside the discharge tube are studied. The reaction $^{20}Ne(p,n)^{20}Na$ was used for the study of neon sodium discharges. The Na atoms produced can be detected by counting the emitted positrons or by a resonance fluorescence method. The latter shows a theoretical detection sensitivity of a few thousand Na atoms per cm^3. This method of detecting isotopes in gas targets can also be used to investigate chemical reactions in gases and atomic processes such as recombination and (ambipolar) diffusion. (auth)

25323 CYCLOTRONS: 1972, AVF AND FM. Howard, F. T. (comp.) (Oak Ridge National Lab., TN). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 9, 689-829(1972).

From 6th international cyclotron conference; Vancouver, B. C. (18 Jul 1972).

See CONF-720717-.

A catalogue of cyclotron installations of the world is presented which lists 70 of the newer type machines that use azimuthally varying magnetic field configurations to maintain isochronism and 17 of the remaining older large machines that use frequency modulation to accommodate the loss of isochronism at relativistic energies. Most of the installations have provided detailed two-page data reports which well describe each machine. The chief activity at the higher energy range is the construction of large machines with sectored magnets. Azimuthal field variations are being incorporated into one or two FM machines. In the low energy field, compact isochronous cyclotrons are being supplied commercially, largely for bio-medical applications. Mid-energy machines are increasingly active in the heavy particle field. No attempt is made here to account for the few remaining standard fixed frequency cyclotrons. (auth)

Auxiliaries and Components

Refer also to abstracts 26044 and 26687.

25324 (AECL-4258) EMITTANCE MEASURING SYSTEM FOR THE MP-TANDEM ACCELERATOR IN MUNICH. Denhoefer, G. (Munich Univ. (West Germany)). Nov 1972. Translated by W. Haeusser from a Thesis. 76p. Dep. NTIS (U. S. Sales Only) $6.00.

A two-slit device for measuring the emittance in the horizontal and vertical plane was developed taking 50 msec for one measurement. The intensity distribution over the phase space is displayed on an oscilloscope. Using the duoplasmatron for 10 MeV protons the measured emittance of the MP-tandem accelerator is: ϵ_x = 3.0 mm mrad and ϵ_y = 2.8 mm mrad. (auth)

25325 (CONF-720565-2) SUPERCONDUCTING PULSED MAGNET SYSTEMS FOR HIGH ENERGY SYNCHROTRONS. Heinz, W. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Experimentelle Kernphysik). Jun 1972. 39p. Dep. NTIS (U. S. Sales Only) $4.00.

From fourth international cryogenic engineering conference; Eindhoven, Netherlands (24 May 1972).

Superconductivity is getting more and more important for future accelerators or for improving existing ones. The higher magnetic fields attainable allow an increase in energy by a factor of 3 to 4 when geometry is kept constant. Especially attractive is the possibility to convert an existing proton synchrotron to higher energies by replacing conventional iron magnets with superconducting ones. Therefore, pulsed superconducting magnets which meet all the requirements of a synchrotron magnet have to be developed with the necessary cryogenic facility. Problems, state of the art and experience with conductors, magnets and cryostats are discussed. (auth)

25326 (EUR-4938, pp 423-430) OPERATING CHARACTERISTICS OF SPARK GAPS AND BANK ASSEMBLY FOR AN ELECTRON-RING ACCELERATOR EXPERIMENT. Suess, R.; Mueller, G. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). Dec. 1972.

From 7th symposium on fusion technology; Grenoble, France (24 Oct 1972).

A 160 kJ bank (30 kV, 1.75 to 2.7 MA) had to be assembled for an electron ring compression and acceleration experiment in Garching. The bank was designed for a maximum repetition frequency of 1 Hz in a series of a few hundred discharges and a total lifetime of 10^5 discharges. Owing to the high repetition and total Coulomb duty, 40 open, atmospheric start and crowbar gaps of the stripline type were chosen to switch the energy of an 8.9 μF (4kJ) section of the bank. The erosion of the electrodes is decreased by parallel switching of at least two arcs across the width (16 cm) of the parallel plate line. This is achieved by extended trigger electrodes in plate geometry having a very-low-inductance inherent capacitance while not imposing high requirements on the rise time and amplitude of the trigger pulse system. The bank has only recently been put into operation with a working frequency of 25 kHz. The load current has a crowbar ripple of 2.5% and a decay time constant of about 400 μs. (auth)

25327 (JINR-P8-6855) APPARATUS FOR DEPOSITION OF SUPERCONDUCTING THIN FILMS. Balalykin, N. I.; Muratov, Yu. V.; Rubin, N. B. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1972. 18p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

An apparatus is described for deposition of multicomponent superconducting films on large surfaces of complex configuration (e.g., working surface of an accelerating resonator of a ringotron; the natural frequency of the resonator being 500 MHz). (auth)

25328 (RHEL/R-264) IMPREGNATION OF SUPERCONDUCTING WINDINGS WITH EPOXY RESINS. PART 1. THEORETICAL CONSIDERATIONS. Colyer, B. (Rutherford High Energy Lab., Chilton (England)). Dec 1972. 47p. Dep. NTIS (U. S. Sales Only) $4.50. UK 50 pence.

The causes of stresses in magnet windings are discussed; thermal contraction stresses and temperature gradient stresses are examined in detail. The initiation and spreading of cracks are considered. The improvement of properties by addition of fillers and flexible polymers is discussed. The work was carried out primarily to aid the development of dipole and quadrupole beam bending and focusing magnets and may also be used in the design of solenoids. (auth)

25329 ARRAY OF QUADRUPOLAR ELECTROSTATIC MICROLENSES. Guernet, G. (to Commissariat a l'Energie Atomique). French Patent 2,122,684. 1 Sep 1972. Filed date 20 Jan 1971. 7p. (In French).

An array of electrostatic quadrupolar microlenses enabling a series of small cross section (mutually parallel and convergent) microbeams to be obtained from a large cross section beam of electrically charged particles is described. The array of electrostatic quadrupolar microlenses is such that each microlens is constituted by two groups, each group consisting of four adjacent electrodes. The electrodes of each of the two groups are positioned in the extension of the electrodes of the other group. These electrodes are of cylindrical form and possess hemispherical ends having the same radius as the cylinder. (France)

25330 DEVICE FOR SIMULTANEOUS CONTROL OF VOLTAGE LEVEL IN THE ACCELERATING CAVITIES AT THE EREVAN SYNCHROTRON. Babayan, A. Z.; Tumanyan, A. R. (Inst. of Physics, Erevan). Izv. Akad. Nauk Arm. SSR, Ser. Fiz.; 7: No. 4, 278-282(1973). (In Russian).

A strobe device with an oscillograph is described that allows the simultaneous measurement of the level of high-frequency voltage in all accelerating cavities for cavity control. (auth)

25331 CALIBRATION OF THE TANDEM ACCELERATOR. Lopez Lopez, J. L. Mexico City; Univ. Nacional Autonoma de Mexico (1972). 84p. (In Spanish).

Thesis.

With the purpose of calibrating the energy of the particle beam from the tandem accelerator, the threshold technique is used with the reactions $^{7}Li(p,n)^{7}Be$ and $^{27}Al(p,n)^{27}Si$. Tests were also made using the resonance of the reaction $^{12}C(p,p)^{12}C$ at 4.806 MeV in order to study the possibility of using it systematically as a norm for the calibration of the accelerator with high precision of the proton bombardment energy. This resonance was chosen because carbon is present as a contaminant in the majority of blanks. The results obtained are discussed. (tr-auth)

25332 CONTROL OF PARTICLE ENERGY AT THE EREVAN SYNCHROTRON. Koshetsyan, G. A.; Tumanyan, A. R. Izv. Akad. Nauk Arm. SSR, Ser. Fiz.; 7: No. 1, 70-72(1972). (In Russian).

A device for the measurement of magnetic field tension in the electron accelerator, which is proportional to the energy of particles in the range 0.5 to 6 GeV with a sensitivity of 1 MeV is described. The signal, proportional to the energy of the particles, is generated as an interval of time, which is convenient for reproduction for a great number of users. (auth)

25333 MONITORING OF THE ACCELERATED BEAM INTENSITY IN AN ELECTRON SYNCHROTRON. Melkumyan, A. G. Tumanyan, A. R. (Inst. of Physics, Erevan). Izv. Akad. Nauk Arm. SSR, Ser. Fiz.; 7: No. 1, 73-76(1972). (In Russian).

The description is given of an accessory device, supplemental equipment and certain modifications of the PP9-1-1M scaler and BAP-5 amplitude converter circuits that provide the automatic switching off of beam acceleration or ejection after n cycles of acceleration, when the total quantity of accelerated or ejected particles reaches the preset value. (auth)

25334 PRINTED CIRCUIT STEERING COILS. Avery, R. T.; Lambertson, G. R.; Pike, C. D. (to United States Atomic Energy Commission). U. S. Patent 3,702,450. 7 Nov 1972. Filed date 11 May 1971. 4p.

A printed circuit steering coil on a flexible board for producing a charged particle beam deflecting magnetic field is described. Rectangular continuous planar spiral coils are etched on the circuit board opposite sides such that as each of at least two boards are bent into cylindrical shapes and disposed interiorly in a steel tube of high permeability permitting beam passage, the coils provide for individual horizontal and vertical steering of the charged particles. (Official Gazette)

25335 ACHROMATIC METHOD FOR MEASURING THE 654 MeV MEAN PROTON ENERGY BY USING VAVILOV–CHERENKOV RADIATION. Zrelov, V. P.; Pavlovic, P.; Sulek, P. (Joint Inst. for Nuclear Research, Dubna, USSR). Nucl. Instrum. Methods; 107: No. 2, 279-284(1973).

The achromatic method for measuring the mean proton energy by using the Vavilov–Cherenkov radiation as well as the results of testing this method in a proton beam of 654 MeV is described. The measurement accuracy is ±0.20 MeV. (auth)

25336 TECHNIQUE TO MEASURE HIGH-POWER ELECTRON BEAM CURRENTS. Pellinen, D.; Staggs, V. (Physics International Co., San Leandro, CA). Rev. Sci. Instrum.; 44: No. 1, 46-49(Jan 1973).

A technique has been used to measure electron beams in excess of 200 kA/cm^2 with energies of 10^5 to 10^6 eV. The technique uses a high-level nanosecond risetime Faraday cup combined with a dielectric differential range filter to separate the primary electrons from low-energy charge carriers in the transport system. This technique has been the one used to measure primary beam currents in excess of 5×10^5 A with pulsewidths on the order of 100 nsec. When combined with a knowledge of particle energy, power flux and deposition profiles may be inferred. A deviation of the electric field generated at the cup collector is included. (auth)

25337 IN-VACUUM FOIL CHANGER FOR INTENSE RELATIVISTIC ELECTRON BEAM GENERATORS. Davitian, H.; Sanford, J.; Fleischmann, H. H. (Cornell Univ., Ithaca, NY). Rev. Sci. Instrum.; 44: No. 1, 83-84(Jan 1973).

A device was built permitting in situ changes of the anode foil of high current electron accelerators and thus allowing sizable pulse rate increases of these accelerators. (auth)

25338 APPLICATION OF A NEW FIELD TRIMMING PROGRAM TO THE MSU CYCLOTRON. Gordon, M. M.; Johnson, D. A. (Michigan State Univ., East Lansing). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 9, 298-307(1972).

From 6th international cyclotron conference; Vancouver, B. C. (18 Jul 1972).

See CONF-720717-.

In order to improve the performance of isochronous cyclotrons, a new computer program "Fielder" has been developed which carries out field trimming calculations on a more rational basis. Using an iterated least-square process, this program adjusts the trim coil currents and the rf frequency so as to fit the (central ray) phase-energy curve to a prescribed function, including a given non-zero initial phase value. In addition, the least-square fitting is subjected to constraints which serve to produce "energy stability" as well as "energy focusing" in the extracted beam. This program has been applied to the MSU cyclotron for a wide range of operating conditions, and has invariably produced significant improvements in the resultant phase-energy curves. (auth)

25339 METHODS OF BEAM PULSING APPLIED AT THE KARLSRUHE ISOCHRONOUS CYCLOTRON. Kappel, W.; Moellenbeck, J.; Schweickert, H. (Kernforschungszentrum, Karlsruhe, Ger.). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 9, 358-365(1972).

From 6th international cyclotron conference; Vancouver, B. C. (18 Jul 1972).

See CONF-720717-.

In the last years more and more experiments at the Karlsruhe Isochronous Cyclotron were performed using a pulsed particle beam (about 30% of the whole machine time). The experiments are: neutron time-of-flight experiments, measurements of the magnetic moments of light nuclei, a study of properties of nuclei far from the stability line, charged particle activation analysis and spin rotation experiments in metals to study internal magnetic fields. This spectrum of experiments requires beam pulses with widths and repetition periods in the time range from nanoseconds to seconds. To cover the whole time range two methods have been developed, a radial and axial deflection system on the first two turns inside the cyclotron and an arc current pulsing of the ion source. The design and performance of the two systems and the diagnostic methods for the resulting beam pulses are described. (auth)

25340 SYSTEM FOR EMITTANCE MEASURING AND MONITORING AT THE JUELICH ISOCHRONOUS CYCLOTRON. Bojowald, J.; Borsch, H.; Kuhlmann, W.; Reich, J.; Retz, A. (Kernforschungsanlage, Juelich, Ger.). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 9, 399-406(1972).

From 6th international cyclotron conference; Vancouver, B. C. (18 Jul 1972).

See CONF-720717-.

The emittance-measuring device of the Juelich Isochronous Cyclotron has been completely rebuilt and improved to be operated in two modes. In the first mode, the whole beam-density profile or its section at a preset density is presented on a XY-recorder in 140 seconds. In the second mode, when using an oscillating magnetic field, the emittance is displayed on a XY-storage oscilloscope in about 10 seconds. The first mode is used for precise emittance measurements. The second mode is an important aid to the operator when adjusting the beam onto the optical axis of the beam-handling system. (auth)

25341 CRYOPUMPING TESTS FOR THE INDIANA UNIVERSITY 200 MeV CYCLOTRON BEAM LINE. Herman, H. (Indiana Univ., Bloomington); O'Neil, J. A. AIP (Amer. Inst. Phys.) Conf. Proc.; No. 9, 419-423(1972).

From 6th international cyclotron conference; Vancouver, B. C. (18 Jul 1972).

See CONF-720717-.

Tests to examine cryopumping the 10 cm beam line have been completed using 180 liter/sec, 18°K refrigerators (cryopumps) without thermal radiation shielding. Full pumping speed (18°K) is reached in less than 20 minutes after pump start. Without supplementary pumping for the non-condensable gases, pressures in the low 10^{-6} Torr range were very easily achieved close to the pump. Vibration imparted to beam line from the pump is minimal. The cost is comparable to other methods of beam line pumping. (auth)

25342 OPTIMIZED USE OF A CYCLOTRON FOR HIGH RESOLUTION STUDIES OF NUCLEI. Kashy, E.; Blosser, H. G.; Johnson, D. A. (Michigan State Univ., East Lansing). AIP (Amer. Inst. Phys.) Conf. Proc.; No. T, 430-437(1972).

From 6th international cyclotron conference; Vancouver, B. C. (18 Jul 1972).

See CONF-720717-.

The effectiveness of an accelerator in nuclear physics research hinges heavily on the energy resolution which can be obtained in actual experiments. Contributions to the resolution from the energy spread and incoherent phase space distribution of the beam, the kinematic effects in the nuclear reaction proper, the energy loss in the target, and the aberrations, must all be included. Optimization for one or the other of these factors is in some cases at the expense of a broadening in other contributions and a compromise point is actually the choice for minimum line width. A manually adjusted optimization system has been in use for some time in the MSU laboratory and has given momentum resolutions of 1 in 20,000 in a variety of test situations and of 1 in 10,000 on a rather regular basis in extended runs. A second generation optimization system is being developed which will make more extensive use of the computer both for calculating best values and for on-line control of system elements. (auth)

25343 FREQUENCY STABILIZATION OF THE TEXAS A AND M CYCLOTRON BY INJECTION LOCKING. Rogers, R. C.; Chenoweth, J. S.; Cox, J. M. (Texas A and M Univ., College Station). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 9, 432-443 (1972).

From 6th international cyclotron conference; Vancouver, B. C. (18 Jul 1972).

See CONF-720717-.

A technique for frequency stabilizing the rf oscillator of a cyclotron without the expense, complexity or power requirements of a fully driven system is described. The system employs a low power (approximately one kilowatt) amplifier driven by a reference frequency signal. The output of the amplifier is coupled to the grid of the power oscillator. This injected signal in conjunction with the servo driven trimming capacitor reduces the average time jitter of the oscillator to less than 100 picoseconds. No significant modification to the power oscillator circuit or in its operation is required. The total components cost for the system is less than three thousand dollars. (auth)

25344 SOME ASPECTS OF THE CONTROL AND STABILIZATION OF THE RF ACCELERATING VOLTAGE IN THE TRIUMF CYCLOTRON. Erdman, K. L. (Univ. of British Columbia, Vancouver); Brackhaus, K. H.; Gummer, R. H. M. AIP (Amer. Inst. Phys.) Conf. Proc.; No. 9, 444-450(1972).

From 6th international cyclotron conference; Vancouver, B. C. (18 Jul 1972).

See CONF-720717-.

The system developed to control the 2 MW 23 MHz rf system at Triumf is discussed. Included are means of pulsing through the multipactoring region; rf accelerating voltage amplitude and phase control; provision of self-excited and driven modes of operation; fine tuning of the resonators; phase and amplitude control of third harmonic voltage for flat-topping of the rf waveform. Results obtained with a prototype control system on the central region cyclotron are included. (auth)

25345 TRIUMF RF AMPLIFIER AND RESONATOR SYSTEM. Erdman, K. L. (Univ. of British Columbia, Vancouver); Poirier, R.; Fredriksson, O. K.; Weldon, J. F.; Grundman, W. A. AIP (Amer. Inst. Phys.) Conf. Proc.; No. 9, 451-458(1972).

From 6th international cyclotron conference; Vancouver, B. C. (18 Jul 1972).

See CONF-720717-.

The TRIUMF rf system consists of a 23.1 MHz fixed frequency driven amplifier with a power capability of 1800 kW. Power is transmitted to the resonator system through a 50 Ω water-cooled line and is coupled to the system by a single coupling loop in one side of the push-pull resonator system. The resonators are constructed of copper-surfaced roll-bond aluminum plates with integral cooling tubes. DC plate power for the four push-pull 4CW250000A tetrode amplifiers is produced in a single unit rated at 20 kV, 130 A with crowbar protection for the tubes. (auth)

25346 WIDE-BAND DRIVEN RF SYSTEM FOR THE BERKELEY 88-INCH CYCLOTRON. Flood, W. S.; Frazier, P. E. (Univ. of California, Berkeley). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 9, 459-466(1972).

From 6th international cyclotron conference; Vancouver, B. C. (18 Jul 1972).

See CONF-720717-.

The wide-band driven rf system, recently commissioned at the Berkeley 88-Inch Cyclotron, offers a much needed lever on dee voltage stability at no sacrifice in rapid tuning flexibility, hopefully at a substantial reduction in tube replacement costs comparative to the original oscillator rf power source. (auth)

25347 RESULTS OF MEASUREMENTS ON A 50 MHz CAVITY DRIVEN BY A 250 kW POWER AMPLIFIER AND THE PRESENT STATUS OF THE RF SYSTEM OF THE SIN CYCLOTRON. Lanz, P. (Swiss Inst. for Nuclear Research, Zurich). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 9, 467-475(1972).

From 6th international cyclotron conference; Vancouver, B. C. (18 Jul 1972).

See CONF-720717-.

The latest developments on the rf system of the SIN ring cyclotron are described. With a power input of 250 kW in one accelerating cavity (Q_0 = 32,000) more than 700 kV peak voltage was measured. At a cavity voltage of 500 kV the phase and amplitude stability are 0.4^0 and 1 in 10^3, respectively. The following subjects are discussed in detail: automatic tuning system, multipactoring, x-rays at high cavity voltage, development of a flat-topping cavity, and the future rf test program. (auth)

25348 TRIUMF CONTROL SYSTEM. Cresswell, J. V. (TRIUMF, Vancouver, B.C.); Heywood, D. R.; Gurd, D. P.; Johnson, R. R.; Lacey, W. K. AIP (Amer. Inst. Phys.) Conf. Proc.; No. 9, 476-484(1972).

From 6th international cyclotron conference; Vancouver, B. C. (18 Jul 1972).

See CONF-720717-.

The TRIUMF cyclotron will be controlled by a computer-driven CAMAC-based system. Data are acquired, displayed and logged automatically at preset intervals while operator commands to modify a machine parameter are serviced in response to interrupts. Branch drivers, branch extenders and control modules have been designed and manufactured. The major features of the system have been implemented and tested on CRM-ISIS and installation is proceeding on the main machine. (auth)

25349 CAMAC CONTROLS APPLICATIONS AT TRIUMF. Dollard, H. (TRIUMF, Vancouver, B.C.); Heywood, D. R.; Marquardt, D. E.; Gurd, D. P.; Johnson, R. R. (AIP (Amer. Inst. Phys.) Conf. Proc.; No. 9, 485-489(1972).

From 6th international cyclotron conference; Vancouver, B. C. (18 Jul 1972).

See CONF-720717-.

Using CAMAC as a design reference, standard modules have been used as signal multiplexer interfaces resulting in cabling reduction and system cost reduction. Prototype CAMAC modules are used to control the central region cyclotron. The console for this cyclotron is operated on an interrupt basis. The console interrupts are enqueued presenting 2 LAM points to the cyclotron 6 CAMAC crate control system. Enqueuing prior to entry into CAMAC can also be done with systems economies. (auth)

25350 COMPUTER CONTROL OF THE INDIANA UNIVERSITY CYCLOTRON FACILITY. Bardin, B. M.; Lewis, S. A.; Plummer, D. J.; Zinneman, T. E. (Indiana Univ., Bloomington). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 9, 490-499(1972).

From 6th international cyclotron conference; Vancouver, B. C. (18 Jul 1972).

See CONF-720717-.

The control system for the Indiana University cyclotron facility is designed to provide monitoring and display of accelerator status, logging and display of operational history, automated beam diagnostics, and presetting of operational parameters, in addition to manual operator control. The operator interacts with a control console which incorporates alphanumeric display terminals, a graphic display, a digital plotter, and various analog input devices. The console is connected to the computer, rather than directly to the accelerator, and the computer acquires data from and sends control information to the accelerator by means of multiplexed ADC's, DAC's, stepping motors, etc. The console and control devices are linked to the computer via a network of modular digital multiplexers which are attached to a common bidirectional data bus. This approach provides decentralization of the interface and allows orderly growth of the system. The computer runs under control of a multiprogramming monitor which executes data acquisition, logging, display, and control programs concurrently, on a priority basis, in response to external signals, operator requests, or on independent schedules. Program development proceeds without interruption of accelerator control. (auth)

25351 COMPUTER CONTROL SYSTEM FOR ORIC. Ludemann, C. A.; Domaschko, J. M.; Mosko, S. W. (Oak Ridge National Lab., TN). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 9, 500-509(1972).

From 6th international cyclotron conference; Vancouver, B.C. (18 Jul 1972).

See CONF-720717-.

A computer control system is being implemented for the Oak Ridge Isochronous Cyclotron (ORIC). At the start of a run, operating parameters are set automatically using data stored in a disc library. Adjustments of these parameters are made through an operator-computer interface consisting of a CRT unit with a keyboard. An array of assignable push-button switches is available for fine tuning various machine parameters. ORIC has 43 ungrounded power supplies requiring adjustment resolution to within 1 part in 10^3 to 1 part in 10^5 depending upon their function. These supplies are controlled by reference voltages derived from 12- to 16-bit digital-to-analog converters (DAC's). A programmable comparator associated with each power supply relays information on power supply performance to the computer. The power supplies, DAC's, and comparators are isolated from the computer by optical couplings and blocking capacitors. The control system sets and fine tunes the rf system, monitors and controls binary functions, switches power supplies to required circuits, alerts the operator if any cyclotron parameter exceeds the specified limits, and processes and stores new run parameters. (auth)

25352 STANDARD CONTROL COMPONENT TO COMPUTER CONTROL BY SIN CYCLOTRON. Besse, L. J. (Swiss Inst. for Nuclear Research, Villigen). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 9, 510-514(1972).

From 6th international cyclotron conference; Vancouver, B. C. (18 Jul 1972).

See CONF-720717-.

The SIN control system is briefly described. The system is modular and based on: control computer (control room); operator's console computer (control room); private manual setpoint settings connected to the ROAD (control room and local); ROAD-system (parallel time/address division multiplexing); and standard control components (local connected to ROAD). (auth)

25353 AUTOMATIC CONTROL OF THE EINDHOVEN A.V.F. CYCLOTRON. I. Measuring Equipment. Schutte, F.; Baghuis, L. C. J.; Hagedoorn, H. L.; Kroonenberg, D. M. J.; Marchand, J. F. P. (Eindhoven Univ. of Tech., Netherlands). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 9, 515-523(1972).

From 6th international cyclotron conference; Vancouver, B. C. (18 Jul 1972).

See CONF-720717-.

For the automatic control of the Eindhoven A.V.F. cyclotron the HF phase angle, the intensity, the extraction efficiency and the horizontal position of the external beam before the magnetic channel are measured continuously and without interception of the beam. For this purpose the signals from capacitive pick-up probes are measured using sampling and correlating techniques. With this experimental set-up intensities of 20 nA are measured and phase variations of 0.1 degree and position variations of 0.1 mm for a beam intensity of 10 μA have been detected. The horizontal and vertical dimensions of the beam in the beam transport system are measured by means of a number of vibrating beam scanners with an accuracy of 0.2 mm down to intensities of 10 nA. The relation between cyclotron parameters and beam properties is assumed to be linear for small variations and is represented by a matrix. Some of the matrix elements can vary slowly in time. They are measured continuously by pulsing the cyclotron parameters involved and correlating the beam response with the small perturbing pulses. All measured data will be supplied to a PDP-9 computer via a CAMAC modular data handling system. (auth)

25354 AUTOMATIC CONTROL OF THE EINDHOVEN A.V.F. CYCLOTRON. II. Measurements. Schutte, F.; Hagedoorn, H. L.; van Heusden, G. C. L.; van Vliet, J. A. J. M. (Eindhoven Univ. of Tech., Netherlands). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 9, 524-530(1972).

From 6th international cyclotron conference; Vancouver, B. C. (18 Jul 1972).

See CONF-720717-.

With the non-interceptive capacitive pick-up probes and experimental set-up described in part I a large number of measurements have been carried out. The dependences of beam properties such as the HF phase angle with respect to the dee voltage, the internal beam intensity, the extraction efficiency and the horizontal position of the external beam on cyclotron parameters such as isochronism, extraction voltage, fringing field gradient and amplitude and azimuthal position of a 1st harmonic field component are discussed. (auth)

25355 NEW BEAM-SPILL CONTROL FOR LAMPF. Parker, J. R.; Richardson, J. H.; Easley, J. D. (Los Alamos Scientific Lab., NM). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 9, 531-537 (1972).

From 6th international cyclotron conference; Vancouver, B. C. (18 Jul 1972).

See CONF-720717-.

The high-intensity beam of LAMPF requires careful control of beam loss to minimize activation of the beam channel. A beam-spill control system now in operation which limits the average beam loss to an amount allowed by activation criteria, without severely restricting accelerator tune-up and diagnostics work, is described. This average loss is maintained by downward modulation of the beam-pulse width and repetition rate until the loss-producing fault is corrected. Binary and analog signals describing the action are sent to the Central Control Computer where decisions regarding corrective measures can be made by either the operator or the computer. The computer can test all beam-spill monitors simultaneously while the machine is in operation. (auth)

25356 FOCUSING BY SUPERCONDUCTING SOLENOIDS IN HIGH ENERGY LINEAR PROTON ACCELERATORS. Bondarev, B. I.; Kushin, V. V.; Murin, B. P.; Solov'ev, L. Yu.; Fedotov, A. P. At. Energ. (USSR); 34: No. 2, 131-133(Feb 1973). (In Russian).

The use of axially symmetrical focusing by a longitudinal magnetic field created by superconducting solenoids permitted the reduction of the aperture of the focusing channel and the power consumed. The particle dynamics are examined, and the parameter tolerances of the focusing channel and the evaluation of the focusing system are discussed. (KSW)

25357 FIELD CORRECTION WINDINGS FOR IRON MAGNETS. Halbach, K. (Univ. of California, Berkeley). Nucl. Instrum. Methods; 107: No. 3, 515-528(1973).

A method is described that allows modification of the field distribution in the iron-free region of magnets. The field modification is obtained by energizing conductors that are imbedded in the iron. The effects of these correction windings are described and rules are given for their proper placement and excitation. (auth)

Ion Sources and Injection and Extraction Systems

25358 (AECL-4224) HIGH CURRENT TEST FACILITY INJECTOR. Ormrod, J. H.; Snedden, M. D.; Ungrin, J. (Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs). Nov 1972. 88p. Dep. NTIS (U. S. Sales Only) $6.50.

The high-current test facility is a proton accelerator consisting of a 750 keV dc injector, beam transport system, buncher and a cw Alvarez structure to accelerate the beam to 3 MeV. The injector and the first leg of the transport system are described as is initial runup to 1% of the design current (100 mA). (auth)

25359 (BNL-17706) COMPUTER PROGRAMS FOR AGS INJECTION. Brown, H. N.; Claus, J. (Brookhaven National Lab., Upton, N. Y.). [nd]. 3p. (CONF-730310-20) Dep. NTIS $3.00.

From fifth Particle accelerator conference; San Francisco, California, USA (5 Mar 1973).

Since the injection system of the AGS requires very tight control over many parameters, computer programs were written to achieve this. One program initiates an emittance measurement device and reduces its output data to provide the characteristics of the linac beam. The second program utilizes these results to set six quadrupoles and four bending magnets so that requested beam parameters are obtained at the inflector exit. A third program measures the circulating beam and attempts to maximize it by adjustment of quadrupoles and bending magnets. These programs and experience in using them on-line are described. (auth)

25360 STUDY OF A HIGH FREQUENCY H^- ION SOURCE: OBTAINING OF AN OPTIMUM CURRENT. Poitevin, J. M. (Univ., Nantes, France). Compt. Rend., Ser. AB; 275: No. 15, 561-564(9 Oct 1972). (In French).

A low power source was studied in view of increasing the yield per cm^3 of consumed hydrogen and per watt of microwave power. The source resonates on the second harmonics of the excitation frequency. Particular attention is given to the geometry of the exchange channel. (FR)

25361 STUDY OF A HIGH FREQUENCY H^- ION SOURCE: OBTAINING OF A VERY PURE BEAM. Poitevin, J. M. (Univ., Nantes, France). Compt. Rend., Ser. AB; 275: No. 13, 455-458 (25 Sep 1972). (In French).

A very pure hydrogen atmosphere was developed in view of obtaining a very pure H^- beam. It was observed that the aging of this type of source is due to the water vapor created by the reaction of hydrogen with the Pyrex of the discharge chamber. A remedy for this effect was found. (FR)

25362 ELECTRON GUN PRODUCING A LARGE CROSS SECTION HIGH INTENSITY AND ABERRATION FREE BEAM. Cortial, H. (to Commissariat a l'Energie Atomique). French Patent 2,119,252. 4 Aug 1972. Filed date 24 Dec 1970. 6p. (In French).

An electron gun intended for Van de Graaff type accelerators is presented. The cathode of the gun possesses a special multiple filament system. Only one of the filaments operates at a given time, the remaining filaments serving as replacements in the event of the failure of the operating filament. The electron gun described is provided with two filaments. (FR)

25363 METHOD OF FAST CHANGE OF DOPANTS FOR ION IMPLANTATION. Boroffka, H.; Krimmel, E. F.; Runge, H. (Siemens AG, Munich). Nucl. Instrum. Methods; 107: No. 2, 251-252(1973).

A method to reduce the time to change dopants in ion implantation systems is described. The source is fed by a suitable mixture of dopant compounds and the desired dopant is selected by mass separation. The down time thus reduces to less than one minute. The main ion optical parameters of the system remain unchanged. (auth)

25364 HORIZONTAL MOTION AND PHASE DILATATION OF AN EXTERNALLY INJECTED ION BEAM. Thimmel, H. M. (AEG Telefunken, Grosswelzheim, Ger.). Nucl. Instrum. Methods; 107: No. 2, 381-384(1973).

The behavior of an axially injected ion beam in the central region of an isochronous cyclotron is described. General Orbit Code calculations performed for the Karlsruhe injection system showed the existence of a remarkable coupling between the radial and azimuthal particle motion. This effect results in a dilatation of the phase width of an externally injected ion beam during the first revolutions. The design of the Karlsruhe axial injection system is characterized by the fact that the hyperbolic inflector, proposed by Mueller, is used. The beam guiding elements in the axial injection line are electrostatic quadrupoles and an einzel lens. (auth)

25365 LINE FOCUSED BEAM FOR HIGH VOLTAGE ACCELERATORS. Kiss, I. (Inst. of Nuclear Research, Debrecen, Hungary); Koltay, E.; Szalay, A.; Shpak, E. V. Nucl. Instrum. Methods; 107: No. 2, 401-403(1973).

A new electrostatic lens is proposed and treated in first order approximation as a tool for forming line shaped beams for high voltage accelerators. (auth)

25366 PRODUCTION OF C AND Al NUCLEI IN A LASER SOURCE OF MULTIPLY-CHARGED IONS. Anan'in, O. B.; Bykovskii, Yu. A.; Degtyarenko, N. N.; (and others) (Moscow Engineering Physics Inst.). JETP Lett. (USSR) (Engl. Transl.); 16: No. 10, 384-387(20 Nov 1972).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 16: No. 10, 543-548(20 Nov 1972).

Fully ionized C^{6+} and Al^{13+} ions were obtained by laser irradiation. Their energy spectra and charge characteristics were studied. An estimate was made of the integral number of ions emitted to a target heated by focused laser radiation with a flux density (3 to 5) $\times 10^{13} W/cm^2$. (MOW)

25367 TECHNOLOGY AND CHEMISTRY OF HEAVY ION SOURCES. Freeman, J. H. (Atomic Energy Research Establishment, Harwell, Eng.); Sidenius, G. Nucl. Instrum. Methods; 107: No. 3, 477-492(1973).

The reliability and behavior of various types of heavy ion sources are described in terms of general design considerations and of the choice of possible constructional materials. The various problems associated with the chemical and metallurgical reactions, which seriously influence the performance of heavy ion sources, are also discussed. A comprehensive table which covers the periodic system and contains recommended source feed compounds and operating procedures, based on the experience obtained on a range of ion beam facilities, is presented. (33 references). (auth)

25368 TRIUMF CENTRAL REGION CYCLOTRON PROGRESS REPORT. Blackmore, E. W. (TRIUMF, Vancouver, B. C. Dutto, G.; Zach, M.; Root, L. AIP (Amer. Inst. Phys.) Conf. Proc.; No. 9, 95-101(1972).

From 6th international cyclotron conference; Vancouver, B. C., (18 Jul 1972).

See CONF-720717-.

The central region cyclotron has been built to investigate beam behavior through the axial injection system and the first five turns of acceleration. A brief description of the resonator structure and the design of the electrostatic inflector is given. Preliminary results of beam tests are discussed. (auth)

25369 CYCLOTRON INJECTION SYSTEMS. Clark, D. J. (Univ. of California, Berkeley). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 9, 191-203(1972).

From 6th international cyclotron conference; Vancouver, B. C. (18 Jul 1972).

See CONF-720717-.

A review is given of the various methods which have been used for injecting beams into cyclotrons from external ion sources. The methods of injection include neutral beam, radial ion, and axial ion systems. The performance of presently operating systems is tabulated. Larger separated sector machines now under construction or proposed will use radial ion systems. (32 references.) (auth)

25370 STATUS REPORT ON AXIAL INJECTION IN THE GRENOBLE CYCLOTRON. Belmont, J. L.; Bois, J. M.; Ferme, J. (Institut des Sciences Nucleaires, Grenoble, France). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 9, 204-210(1972).

From 6th international cyclotron conference; Vancouver, B. C. (18 Jul 1972).

See CONF-720717-.

The axial injection system has been used since 1969 for the ex-

periments with a polarized proton or deuteron beam. A system for the pulsation of the beam of a duoplasmatron is now being added. It is planned to modify the system for the injection of multicharged heavy ions. (auth)

25371 IMPROVED BIRMINGHAM POLARIZED DEUTERON SOURCE AND INJECTION OF THE BEAM INTO THE CYCLOTRON. Guest, G.; Hardy, W.; Oh, S.; Powell, W. B. (Univ. of Birmingham, Eng.). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 9, 211-215(1972).

From 6th international cyclotron conference; Vancouver, B. C. (18 Jul 1972).

See CONF-720717-.

The stage one updating program on the Radial Ridge Cyclotron polarized D^+ source has been recently completed. Initial tests and measurements have been carried out on the improved stability, beam quality, and intensity. (auth)

25372 ION SOURCE AND INJECTION SYSTEM (ISIS) FOR THE TRIUMF CENTRAL REGION MODEL (CRM). Duelli, B. L.; Joho, W.; Roedel, V.; White, B. L. (TRIUMF, Vancouver, B. C.). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 9, 216-225(1972).

From 6th international cyclotron conference; Vancouver, B. C. (18 Jul 1972).

See CONF-720717-.

The central region model was built primarily for checking the beam dynamical properties of the first five turns in the TRIUMF 500 MeV cyclotron. It also serves as an ideal model for a high intensity H^- ion source and injection system. The H^- ions are produced in an "Ehlers-type" source (from Cyclotron Corporation), accelerated to 300 keV by a low gradient acceleration tube and axially injected into the central region model by a spiral inflector. The 22 m long beam transport system between source and central region consists of three 90 deg electrical bends (non dispersive), about 50 electrostatic quadrupoles, a buncher and a chopper. A pulser for changing the macroscopic duty cycle and a 1:5 selector which suppresses 4 out of 5 beam bunches are to be installed later. Beam measurements and calculations have shown that space-charge effects play an important role for currents above 100 μA. (auth)

25373 FILLING OF THE PHASE SPACE IN THE CENTRAL REGION OF A SYNCHROCYCLOTRON. Thouroude, D. (Univ., Rennes, France). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 9, 226-231(1972).

From 6th international cyclotron conference; Vancouver, B. C. (18 Jul 1972).

See CONF-720717-.

Numerical methods have been used to study the filling of the energy-phase plane and the evolution of the beam during capture time. Beam shapes and distribution of particle densities can thus be obtained at various instants in phase and median planes. The results are meant to be used in studying space charge effects during injection. (auth)

25374 HEAVY ION BEAMS AT THE TEXAS A AND M CYCLOTRON USING A COLD-CATHODE SOURCE. Kenefick, R. A.; Chapman, W. W.; Chamberlin, E. P. Contract AT(40-1)-3398. AIP (Amer. Inst. Phys.) Conf. Proc.; No. 9, 258-264(1972).

From 6th international cyclotron conference; Vancouver, B. C. (18 Jul 1972).

See CONF-720717-.

An internal cold-cathode Penning source which is highly compatible with the instrumentation for the conventional filament source has been used to accelerate heavy ions. Initial unoptimized operation has produced external beam currents ≥ 5 eua of C^{3+}, C^{4+}, N^{3+}, N^{4+}, and O^{4+}. External currents <1 eua of Ne^{5+} and Ar^{5+} have also been obtained. Extraction efficiency for these beams ranges from 30% to 60%. Acceleration and extraction of ions have so far been limited to first and third harmonic operation and beam velocities range from 2.1 MeV/nucleon (C^{4+}). Typical arc power is 1.5 to 3 kW although it has been operated at 5 kW for extended periods. Source lifetime has been limited to 4 to 6 hours by cathode-anode shorting due to "stalactites" of evaporated anode material. Some of the techniques used for tuning new heavy ion beams to extraction are described. (auth)

25375 ASPECTS OF OPTIMIZATION OF BEAM ACCELERATION AND EXTRACTION CONDITIONS IN CYCLOTRON WITH EXTERNAL ACTIVE MONOCHROMATIZATION SYSTEM. Basargin, Yu. G. (Scientific Research Inst. of Electrophysical Apparatus, Leningrad); Litunovskii, R. N.; Severgin, Yu. P.; Venikov, N. I. AIP (Amer. Inst. Phys.) Conf. Proc.; No. 9, 315-321(1972).

From 6th international cyclotron conference; Vancouver, B. C. (18 Jul 1972).

See CONF-720717-.

The results of the investigation of optimization of acceleration conditions and beam extraction in the 200 to 300 MeV ring cyclotron, operating together with an external active monochromatization system, are reported. It is shown, that it is possible to obtain a beam with a current of some tens of microampere with transverse emittance 3π mm mrad at energy inhomogeneity 2.10^{-4} and duty factor 0.2. (auth)

Ion Optics and Field Calculations

Refer also to abstract 25794.

25376 (BNL-17569) TRANSVERSE COHERENCE DUE TO A TIME VARYING DIPOLE DEFLECTION. Month, M. (Brookhaven National Lab., Upton, N. Y.). 8 Jan 1973. 21p. Dep. NTIS.

The effect on one-dimensional coherent transverse betatron motion of a time-dependent dipole perturbation is considered. The method used applies in cases where the tune is not a function of the betatron amplitude, but is a function of either momentum or the betatron amplitude in the other transverse dimension. An equation for the transverse position response of the beam, i.e., the dipole moment per unit length, is derived. The initial value problem is solved. For the case of rf knockout the steady-state solution is obtained as the limit $t \to \infty$. Some care must be exercised in taking this limit and this subject is gone into. Specifically, the origin of the ν-plane integration contour is given. The effect of space charge and image forces on the beam response is derived. The implications of this influence with respect to the use of rf knockout for measuring the parameters of the transverse collective instability are discussed. Finally, the case of a short-pulse perturbation is considered. (auth)

25377 (NP-19692) FIELD ABERRATIONS IN SUPERCONDUCTING DIPOLE AND QUADRUPOLE MAGNETS FOR A SUPERCONDUCTING SYNCHROTRON. Green, M. A. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Experimentelle Kernphysik). Jun 1972. 77p. Dep. NTIS (U. S. Sales Only) $6.00.

Various kinds of field aberrations that can occur in superconducting dipole and quadrupole magnets are discussed. These aberrations are divided into two basic kinds, those which produce asymmetric multipoles and those which produce symmetric multipoles. Some of the field errors are caused by conductor placement problems; others are caused by various electrical and magnetic phenomena. The tolerance limits that must be put on conductor position are discussed, and methods for preventing and correcting various aberrations are discussed. Finally, one method for building model magnets and measuring these magnets to detect, correct, and prevent the various kinds of aberration which can occur in the copper and superconducting model magnets is presented. (auth)

25378 (UCID-16223) UNIVERSAL BEAM ENVELOPE CURVES INCLUDING THE EFFECTS OF EMITTANCE AND ATTRACTIVE OR REPULSIVE SELF-FORCE. Lauer, E. J.; Leary, J. M. (California Univ., Livermore. Lawrence Livermore Lab.). 1 Feb 1973. Contract W-7405-eng-48. 30p. Dep. NTIS $3.50.

Some numerical solutions of the differential equation for the beam envelope radius as a function of axial distance z assuming uniform current density inside a circular envelope are presented. The attractive case is emphasized. The differential equation was analyzed and the period and amplitude of oscillation are predicted. The numerical solutions are in complete agreement with the theoretical values. A derivation is given of the envelope equation for completeness which uses the equation of motion of a particle on the surface of the beam. The derivation of the adiabatic invariant using the WKB solution of the particle equation of motion is outlined. An important observation is that if the beam is introduced into the experimental tank with a radius mismatched to its equilibrium radius then there can be huge oscillations in beam radius going down the tank. (WHK)

25379 INSTABILITY OF COHERENT BETATRON OSCILLATIONS OF BUNCHED BEAMS IN CIRCULAR-ORBIT ACCELERATORS BY INTERACTION BETWEEN BEAM AND RESONANCE SYSTEMS. Grigor'ev, V. P.; Veingardt, V. F. (Tomsk Polytechnic Inst., USSR). Izv. Vyssh. Ucheb. Zaved., Radiofiz.; 15: No. 12, 1932-1938(1972). (In Russian).

The stability of transverse oscillations of charged particle beams interacting with resonance systems is considered in the linear approximation. The increments are found and the stability criteria of betatron oscillations are determined. (auth)

25380 SIMPLE METHOD FOR DETERMINING POLE PROFILES FOR MAGNETS WITH WEAK FOCUSING. Geske, G. (Univ., Jena, Ger.). Exp. Tech. Phys.; 20: No. 3, 263-268(1972). (In German).

The description and proof of a simple method by which the pole profile of magnets that shall generate a given structure of the field in the region between the poles can be evaluated by using experimentally gained values of the field strength are given. (auth)

25381 OPTIMIZED MULTI-PARTICLE CENTRAL REGION FOR THE MICHIGAN STATE UNIVERSITY ISOCHRONOUS CYCLOTRON. Learn, L. L.; Blosser, H. G.; Gordon, M. M. (Michigan State Univ., East Lansing). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 9, 291-297(1972).

From 6th international cyclotron conference; Vancouver, B. C. (18 Jul 1972).

See CONF-720717-.

Centered orbits are highly desirable in a cyclotron since problems with resonances are minimized and beam stability is greatly improved. The Michigan State University Cyclotron, as originally designed, produces accurately centered orbits in first harmonic operation and performs acceptably on second harmonic. Third harmonic operation, on the other hand, has never been adequate due to very large centering errors. The basic origin of these centering problems is the gap crossing resonance, and the effect of this resonance is highly sensitive to the angular width of the dees. Studies herein show that with a proper selection of both the central region geometry and the dee angle this centering problem can be effectively eliminated. Appropriate configurations have been worked out for harmonics H = 1, 2, and 3, using 138°, 90°, and 60° dees, respectively, and confirmed in electrolytic tank studies. To implement this new design, a major cyclotron improvement program has been initiated based on a system of interchangeable dees. Basic features of this new design and computational results for the optimized geometries are discussed. (auth)

25382 SOME PECULIARITIES OF LONGITUDINAL MOTION OF THE PARTICLES IN AN ISOCHRONOUS CYCLOTRON. Basargin, Yu. G.; Litunovskii, R. N.; Minyaev, O. A.; Vasil'ev, V. I. (Scientific Research Inst. of Electrophysical Apparatus, Leningrad). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 9, 322-328(1972).

From 6th international cyclotron conference; Vancouver, B. C. (18 Jul 1972).

See CONF-720717-.

The results of a numerical investigation of the effects of transverse motion on the time duration of the ion bunch in the isochronous cyclotron are reported. The requirements for the control of transverse motion parameters at beam extraction from the isochronous radius and for the region with dropping magnetic field are formulated. The ion entry into the additional bunching dee operating at the highest harmonic compared with the accelerating voltage of the main dee is investigated. The results of numerical modelling of the beam acceleration in the ring isochronous cyclotron with a double-acceleration system with beam extraction near the radial stability boundary are given. (auth)

25383 EFFECTS OF AXIAL MISALIGNMENT OF THE DEES AND THEIR CORRECTION. Craddock, M. K. (Univ. of British Columbia, Vancouver); Dutto, G.; Kost, C. AIP (Amer. Inst. Phys.) Conf. Proc.; No. 9, 329-339(1972).

From 6th international cyclotron conference; Vancouver, B. C. (18 Jul 1972).

See CONF-720717-.

Axial misalignment of the dees near the center of a cyclotron can lead to the build-up of large coherent axial oscillations. Numerical computations made for the TRIUMF cyclotron are shown to be in agreement with an analytic treatment of the problem. General formulae are given, applicable to all cyclotrons. In the case of TRIUMF the tolerance allowed on the vertical positions of the dee lips in order to maintain beam quality is ±0.25 mm, quite tight considering the size of the cyclotron. Various methods of reducing the effects of dee misalignment are considered. For TRIUMF, a system of specially shaped electrostatic deflecting plates acting over the first few turns has been proposed; these could relax the misalignment tolerance by a factor of four. Other advantages and disadvantages of this scheme are discussed, including its effects on the radial motion. (auth)

25384 EFFECT OF CERTAIN MAGNETIC IMPERFECTIONS ON THE BEAM QUALITY IN TRIUMF. Boiduc, J. L. (Univ. of British Columbia, Vancouver); Mackenzie, G.H. AIP (Amer. Inst. Phys.) Conf. Proc.; No. 9, 351-357(1972).

From 6th international cyclotron conference; Vancouver, B. C. (18 Jul 1972).

See CONF-720717-.

The tolerances imposed on certain imperfections in the TRIUMF magnetic field by the resonances $\nu_x = 1/1$, $2/2$, $3/2$ and $6/4$, $\nu_z = 1/2$ and $\nu_x - \nu_z = 1$, and by the height of the equilibrium orbit are discussed. A method of calculating harmonic coil settings to center a beam of wide phase width is described. (auth)

25385 ORBIT STUDIES FOR THE INDIANA UNIVERSITY CYCLOTRON. Jones, W. P.; Friesel, D. L.; Bardin, B. M. (Indiana Univ., Bloomington). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 9, 374-378(1972).

From 6th international cyclotron conference; Vancouver, B. C. (18 Jul 1972).

See CONF-720717-.

The effects of a spiral isochronizing coil as an alternative to the use of a series of radial gradient coils for field isochronization of the Indiana University cyclotron are discussed. The calculations using measured magnetic fields indicate that such a coil yields improvement with regard to the betatron oscillation resonances encountered in this machine. Calculations involving the design of the inflector system and phase selection slits are also described. (auth)

25386 RESONANT DEPOLARIZATION EFFECTS FOR POLARIZED BEAMS IN THE INDIANA UNIVERSITY CYCLOTRON. Moffa, P. J.; Bacher, A. D.; Jones, W. P.; Schwandt, P. (Indiana Univ., Bloomington). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 9, 379-383(1972).

From 6th international cyclotron conference; Vancouver, B. C. (18 Jul 1972).

See CONF-720717-.

Resonant depolarization effects have been investigated for axially polarized beams accelerated in cyclotrons of the four-sector, separated-magnet configuration under construction at Indiana University. No intrinsic depolarizing resonances were encountered in the final cyclotron stage for beams of protons, deuterons, and ^{3}He ions. Depolarization probabilities for resonances present in the injector cyclotron stage were determined to be $<10^{-6}$. (auth)

25387 COMPARISON OF VARIOUS GEOMETRIES OF A SEPARATED SECTOR CYCLOTRON. Kanunnikov, V. N.; Papadichev, V. A. (Lebedev Inst. of Physics, Moscow). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 9, 384-392(1972).

From 6th international cyclotron conference; Vancouver, B. C. (18 Jul 1972).

See CONF-720717-.

Using an analytical approximation for the magnetic field of a separated-sector isochronous cyclotron, the various geometries of the cyclotron magnet system are analyzed from the dynamical point of view. The following geometries are considered: a radial-sector magnet system having a constant vertical gap, a magnet having a variable gap and azimuthal sector width, and a system of radial sectors displaced relative to the center of the cyclotron. It is shown that the last case provides acceptable field characteristics and reasonable simplicity of geometry. (auth)

25388 DETERMINATION OF NON-LINEAR COMPONENTS IN CORPUSCULAR-OPTICAL ELEMENTS BY INCREMENTAL HALL-PROBE MEASUREMENT TAKING INTO ACCOUNT SYSTEMATIC ERRORS DUE TO LONGITUDINAL FIELD COMPONENTS AND SAG OF THE PROBE ARM. Jung, V. (Kernforschungszentrum, Karlsruhe, Ger.). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 9, 415-418(1972).

From 6th international cyclotron conference; Vancouver, B. C. (18 Jul 1972).

See CONF-720717-.

For determination of non-linear field components along the beam axis of a quadrupole field an incremental Hall-probe measurement is proposed. The small sensitive length of a Hall-probe allows to measure the detailed field distribution needed for high precision beam calculations. Systematic errors due to longitudinal field components and sag of the probe arm can be eliminated. (auth)

25389 TRANSFER MATRIX METHOD FOR COMPUTING DEPOLARIZATION EFFECTS OF A POLARIZED PROTON BEAM IN A TRANSPORT SYSTEM. Rapin, D.; Hess, R.; Nikles, J. C.; Werren, D. W. (Univ., Geneva). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 9, 425-429(1972).

From 6th international cyclotron conference; Vancouver, B. C. (18 Jul 1972).

See CONF-720717-.

Transfer matrices T used in the expression $\vec{S}_{out} = T \cdot \vec{S}_{in}$ for computing the spin precession of relativistic protons are discussed. In particular, the matrix elements are given to first order approximation for a quadrupole, a bending magnet with inclusion of entrance and exit path, and a solenoid. (auth)

25390 CALCULATIONS ON THE ION-BEAM TRANSPORT SYSTEM OF THE TANDEM ACCELERATOR AT UPPSALA. Olsmats, M.; Wannberg, B. (Univ. of Uppsala). Nucl. Instrum. Methods; 107: No. 3, 563-568(1973).

The ion-optical properties of the beam-handling system of the tandem Van de Graaff accelerator at Uppsala are studied. The purpose of the investigation is to ascertain the positions of the quadrupole magnets and experimental set-ups most appropriate for each experiment. The influence on the time-spread of a pulsed beam is analyzed. It is found that, in order to fully utilize the pulsing system of the accelerator, the beam must have a waist inside the analyzing magnet, necessitating direct stabilization of the accelerating voltage. (auth)

25391 CONDITIONS FOR THE APPEARANCE OF BEAM INSTABILITIES IN A SINGLE SUPERCONDUCTING TM_{010} CAVITY. Septier, A.; Boussoukaya, M. (Paris Univ., Orsay, France). Nucl. Instrum. Methods; 107: No. 3, 437-443(1973). (In French).

A study of conditions for B.B.U. is done on a superconducting accelerating cavity working in the TM_{010} mode in S-band. Only the deflecting modes TM_{110} and TM_{111} excited by the beam are studied. The threshold values of the mean electron beam current for which deflecting modes appear in the cavity are 50 and 85 μA for the TM_{110} and TM_{111} modes respectively, for $Q_{010} = 10^9$. (auth)

25392 COMPUTATIONAL STUDY OF THE NON-LINEAR STAGE OF THE DEVELOPMENT OF RADIATION INSTABILITY IN RELATIVISTIC ELECTRON RINGS. Shchinov, B. G.; Bonch-Osmolovskii, A. G.; Makhankov, V. G.; Tsytovich, V. N. (Joint Inst. for Nuclear Research, Dubna, USSR). Plasma Phys.; 15: No. 3, 211-225(Mar 1973).

The evolution of the instability of a thin relativistic electron ring has been investigated numerically. The solution of the exact nonlinear equation is obtained involving the interactions of ten harmonics of the coherent radiation. Both the radiation effects and the negative mass effects have been considered for a ring in free space. It is found that for short times, of order several linear growth times, the instability saturates at a relatively low level of oscillation energy. This saturation is accompanied by an increase in the energy spread of the beam up to a threshold value and with the distribution of energy among several harmonics. (auth)

Storage Rings

25393 (BNL-17397) HIGH MOMENTUM DISPERSION-LOW β MATCHED INSERTION. Month, M. (Brookhaven National Lab., Upton, N. Y.). 9 Nov 1972. 10p. Dep. NTIS $3.00.

The general difficulties connected with the design of a matched insertion which has a free straight section with high X_p and low β_H are discussed. A practical resolution of these problems is provided. A specific example of a matched symmetric insertion is presented. Some general aspects related to storage ring design are also considered. (auth)

25394 (BNL-17656) TRANSVERSE COLLECTIVE INSTABILITY EXCITED BY A NONUNIFORM ν-SHIFT IN INTENSE BEAMS. Month, M.; Jellett, K. (Brookhaven National Lab., Upton, N. Y.). 6 Feb 1973. 18p. Dep. NTIS $3.00.

A model which describes the effect of a nonuniform space charge ν-shift on the resistive wall instability associated with transverse collective oscillations of a beam of particles is proposed. It successfully predicts the overall characteristics of the instability as observed at the CERN ISR: (1) the observation of a current limitation in spite of the proportionate increase in ν-spread as charge is stacked; and (2) the fact that at the onset of instability, beam losses occur at a particular edge of the beam. The suggestion is simply that the original model of the resistive wall instability is applicable, but the effect on the betatron tune of the space-charge forces is directly on the ν-value density distribution. It is shown that under certain circumstances, this distortion of the density function can excite the instability. An important result is that the stable region in W-space (W is a complex quantity depending on the beam characteristics and its environment) is not diminished by the distortion, but rather shifted. The implications of this result is the notion of an optimization of design such that stability remains even as the beam intensifies and the distortion increases. (auth)

25395 (BNL-17683) HARMONIC CONTENT OF THE ENDS IN THE COSINE THETA ISABELLE DIPOLES. Morgan, G. H. (Brookhaven National Lab., Upton, N. Y.). 5 Feb 1973. 5p. Dep. NTIS $3.00.

Utilizing the theory developed by Mills and Morgan ("A Flux Theorem for the Design of Magnet Coil Ends," F. Mills and G. Morgan to be submitted to Particle Accelerators), the harmonic content of an ISABELLE model dipole has been calculated and a modification arrived at which eliminates the sextupole and minimizes higher harmonics. (auth)

25396 (BNL-17698) EXPERIMENTAL INSERTIONS FOR THE ISA. Chasman, R.; Courant, E. D.; Month, M.; van Steenbergen, A. (Brookhaven National Lab., Upton, N. Y.). 1972. 3p. (CONF-730310-21) Dep. NTIS $3.00.

From fifth Particle accelerator conference; San Francisco, California, USA (5 Mar 1973).

The general design features of experimental insertions for the ISA storage accelerators are presented. Various insertions which satisfy the requirements for specific high energy particle experiments are discussed. Some consideration is given to (a) the distribution of the insertions in the lattice; (b) the separation of experimental areas from those used for injection and protective extraction; (c) the subject of beam crossing; (d) the implications of high β, high quadrupole gradient conditions required in the insertions; and (e) general characteristics, including luminosity and beam momentum spread. (auth)

25397 (SLAC-158) BEAM POLARIZATION EFFECTS IN HIGH ENERGY ELECTRON-POSITRON STORAGE RINGS. Ford, W. T.; Mann, A. K.; Ling, T. Y. (Stanford Linear Accelerator Center, Calif.). Nov 1972. Contract AT(04-3)-515. 42p. Dep. NTIS $3.00.

Calculations are presented of beam polarization-dependent effects in high energy e^+e^- storage rings. The elastic scattering within a circulating bunch (Touschek scattering) leads to a net polarization-dependent effect of 5 to 10% for parameters appropriate to SPEAR, viz. $E_0 = 2.5$ GeV, $\Delta E/E_0 = 0.05$, and $\delta P_\perp = 0.6$ MeV, where E_0 is the storage ring energy, ΔE is the average energy exchanged in the collisions and $\delta P_\perp$ is the width of the radial momentum distribution in the bunch. The final state angular distributions of the scattering processes $e^+e^- \to e^+e^-$, $e^+e^- \to \mu^+\mu^-$ and $e^+e^- \to \gamma\gamma$ are considerably modified by beam polarization, even for relatively low values of the time-averaged polarization. Calculations of counting rates and polarization-dependent effects for these e^+e^- collision processes are given. (auth)

25398 (SLAC-Trans-151) COLLECTIVE INSTABILITY OF COMPENSATED COLLIDING BEAMS. Derbenev, Ya. S. (Akademiya Nauk SSSR, Novosibirsk. Institut Yadernoi Fiziki). Translation of IYAF-70-72. (CONF-721029-5). 1972. 10p. Dep. NTIS.

From third all-union national conference on particle accelerators; Moscow, USSR (2 Oct 1972).

It has been shown that the equilibrium state of a system of four beams with compensated interaction at the place of collision is unstable with respect to relatively small multipole (in the general case) excitations breaking up the compensation. The instability has a dynamic resonance character and leads to splitting of the beams in which compensation is practically absent. Estimates show that this phenomenon makes it impossible to obtain an appreciable gain in luminosity in installations with four beams in comparison with conventional storage rings. (auth)

25399 (SLAC-Trans-152) PHASE EFFECTS OF INTERACTING COLLIDING BUNCHES IN STRONG-FOCUSING STORAGE RINGS. Derbenev, Ya. S.; Skrinskii, A. N. (Akademiya Nauk SSSR, Novosibirsk. Institut Yadernoi Fiziki). Translation of IYAF-71-72. (CONF-721029-6). 1972. 10p. Dep. NTIS $3.00.

From 3rd all-union national conference on particle accelerators; Moscow, USSR (2 Oct 1972).

It has been shown that in storage rings with inhomogeneous focussing the potential well of the energy oscillations of the particles is distorted under the influence of the colliding bunch, up to the loss of stability of the equilibrium phase at sufficiently high current. The effect depends only weakly on the transverse dimensions of the colliding bunch and on amplitudes of the oscillations of particles, but increases rapidly as their azimuthal modulation is increased. This interaction mechanism also leads to coupling of the coherent phase oscillations of the colliding bunches. Together with the effect of a change in synchrotron mass, these phenomena should be taken into account when designing installations with small values of the β-function at the place of collision. (auth)

25400 (SLAC-Trans-154) DESORPTION DUE TO SYNCHROTRON LIGHT IN ELECTRON-POSITRON COLLISION RINGS. Liot, R. (Paris Univ., Orsay (France). Laboratoire de l'Accelerateur Lineaire). Translation of Technical Report 3-72. (CONF-720572-1). 1972. 11p. Dep. NTIS $3.00.

From Vacuum technology meeting; Versailles, France (30 May 1972).

The problem of outgassing due to synchrotron radiation incident on the vacuum walls was studied and it was concluded that

the measures taken in the construction of the CRI collision ring concerning the production of sufficiently high vacuum should ensure a lifetime of several hours for the stored beams, even under unfavorable assumptions concerning the over-all degassing level and the composition of this gas. (WHK)

25401 (SLAC-Trans-155) DEGASSING SPECTRA OF SOME MATERIALS FOR CONSTRUCTING THE VACUUM CHAMBER OF A 1.8 GeV ELECTRON-POSITRON COLLISION RING. Souchet, R. (Paris Univ., Orsay (France). Laboratoire de l'Accelerateur Lineaire). Translation of Technical Report 4-72. (CONF-720572-2). 1972. 19p. Dep. NTIS $3.00.

From Vacuum technology meeting; Versailles, France (30 May 1972).

A brief description of the collision ring installation (CRI) at Orsay precedes the results of the measurements, with a discussion of the interpretation of the spectra for calculating the partial pressures. (auth)

Experimental Facilities

Refer also to abstracts 24696 and 24708.

25402 (KFK-1675) KARLSRUHE FAST NEUTRON TIME-OF-FLIGHT FACILITY. Cierjacks, S. (Kernforschungzentrum, Karlsruhe (West Germany). Institut fuer Angewandte Kernphysik). Aug 1972. 20p. (CONF-720701-9). Dep. NTIS (U. S. Sales Only) $3.00.

From International conference on nuclear structure study with neutrons; Budapest, Hungary (31 Jul 1972).

The fast neutron time-of-flight spectrometer installed at the Karlsruhe sector-focused cyclotron is discussed as an example of a high intensity pulsed neutron source. A description of the operation principles of this facility, a few examples of typical measurements which have been carried out and an outline of the scope and the capability of the spectrometer are given. The performance data for this spectrometer are compared with those for some other accelerator-based high-intensity neutron sources in Europe. (auth)

25403 (UCRL-51317) PEAK FLUX MEASUREMENTS OF THE LLL HIGH-INTENSITY 14-MeV NEUTRON SOURCE. Goldberg, E.; Griffith, R.; Logan, C. (California Univ., Livermore. Lawrence Livermore Lab). Dec 1972. Contract W-7405-eng-48. 16p. Dep. NTIS.

The high-intensity D-T neutron source in operation at LLL permits a close approach to the actual neutron-producing region. Peak flux values have been studied analytically and are seen to be strong functions of the spot size of the beam and the minimum distance of approach. Comparison of analytic and Monte Carlo calculations with experiments involving zirconium and sulphur discs lead to inferred source spot diameters not larger than 1.0 cm and minimum spacing of 0.3 to 0.4 cm. Measurements show that for a readily attainable intensity of 2×10^{12} n/sec from a new target, a peak flux of 5.5×10^{11} n/cm^2-sec can be realized. Further, a peak flux of 9×10^{11} n/cm^2-sec is easily within the capabilities of the present facility for an intensity of 2×10^{12} n/sec. (auth)

25404 VACUUM CHAMBER INTENDED PRINCIPALLY FOR THE SCANNING DEVICE OF A PARTICLE ACCELERATOR. Leboutet, H.; Benussan, A. (to Thomson-CSF). French Patent 2,116,761. 21 Jul 1972. Filed date 7 Dec 1970. 5p. (In French).

A vacuum chamber intended for the scanning device of an industrial irradiation electron accelerator is presented. The surface of the chamber is in the form of a truncated elliptical cross sectioned cone whose ends are fixed to two thick parallel flanges. (FR)

25405 ELECTRON BEAM SCANNING WITH NARROW FIELD COMBINED WITH THE AUTOMATIC ENERGY CHANGE. Ueda, Toshio; Kimura, Chiaki (Aichi Cancer Center, Nagoya, Japan). Nippon Igaku Hoshasen Gakkai Zasshi; 31: No. 8, 949-958(Nov 1971). (In Japanese).

A new method for the treatment of tumors with high-energy electrons at various depths below the skin is described. An instrument was constructed and was able to select the appropriate energy automatically in proportion to the thickness of the tumor during the electron beam scanning. An equilibrium orbit timing mechanism was used for changing the energy. Dose distributions were measured using polystyrene slab phantoms by the film method and satisfactory isodose curves were obtained. In this mechanism, desirable dose distributions are obtained by selecting the combination of appropriate energy in proportion to the thickness of the tumor. Furthermore, the influence of electron beam scanning with a narrow field on the depth dose curves and the influence of energy changes of the beam flatness and the dose rate during the scanning with energy changes are discussed. (auth)

25406 METHOD OF INDIRECTLY MONITORING THE OUTPUT OF A PULSED NEUTRON SOURCE. Caldwell, R. L.; Givens, W. W. U. S. Patent 3,710,112. 9 Jan 1973. Filed date 18 May 1970. 6p.

The specification discusses a borehole tool for assaying for uranium. It consists of a pulsed neutron source of the accelerator type and a detector for detecting delayed fission neutrons. In operation, the source is periodically actuated to produce very short neutron bursts having a duration of a few microseconds or less. Located adjacent the source is a gamma-ray detector for detecting delayed gamma rays emitted from oxygen in the formations when irradiated with neutrons—the gamma rays result from the reaction $^{16}O(n,p)^{16}N \rightarrow {}^{16}O + \gamma$. These gamma rays are recorded to obtain an indirect measure of the neutron output produced by the source. (Official Gazette)

25407 DATA ACQUISITION FROM SIMULTANEOUS EXPERIMENTS USING THE MSU SIGMA-7 COMPUTER. McHarris, W. C.; Au, R. F.; Bayer, D. L.; (and others) (Michigan State Univ., East Lansing). pp 323-335 of Radioactivity in Nuclear Spectroscopy. Vol. I. Hamilton, J. H. (Ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From International Conference on Radioactivity in Nuclear Spectroscopy; Nashville, Tennessee, United States of America (USA) (11 Aug 1969). See CONF-690818-(Vol. 1).

The Sigma-7 computer at the Cyclotron Laboratory at Michigan State University forms the basis of a flexible real-time, time-sharing system. The interfacing hardware and time-sharing software are both products of the laboratory and permit simultaneous data taking by as many as four experiments. A typical situation would be an extended multiparameter Ge(Li)-Ge(Li) coincidence experiment running at the same time as a scattering experiment using the computer to identify multiple particles. While these experiments are running one can simultaneously analyze data using a scope, plot data, and run several computations. The computations can be as large as 128K words, permitting such programs as the DWBA code JULIE. Computer control of the Michigan State University Sector-Focussed Cyclotron is partially operational and will be completed in the fall of 1969. Descriptions of the programs of most interest for the acquisition and analysis of spectra resulting from radioactivity are given, including those for collecting multiparameter spectra and those for spectrum analysis. Programs currently in use for scattering experiments, including ΔE-E and time-of-flight identification, are discussed in terms of their applicability to on-line spectroscopy. (auth)

25408 PREPARATION OF TANTALUM NITRIDE TARGETS BY REACTIVE SPUTTERING. Wormald, M. R.; Underwood, B. Y.; Allen, K. W. (Nuclear Physics Lab., Oxford). Nucl. Instrum. Methods; 107: No. 2, 233-235(1973).

A method of making thin nitride films for nuclear targets by reactive sputtering is discussed. The process is found to be simple and reliable and is capable of producing high-purity films on a wide range of backings. (auth)

25409 HIGH QUALITY ELECTRON AND PION BEAM FOR NAL. Guiragossian, Z. G. T.; Rand, R. E. (Stanford Univ., CA). Nucl. Instrum. Methods; 107: No. 2, 237-250(1973).

A design for a secondary electron beam suitable for electron scattering experiments at the National Accelerator Laboratory is presented. Using standard NAL beam transport magnets it will operate at up to 300 GeV/c with the following properties: acceptance 9.5 μsr % $\Delta p/p$ (fw), momentum bite $\pm 2\%$, momentum resolution of momentum hodoscope $\Delta p/p = \pm 0.30\%$ (hw at base), final spot size $\leq \pm 3.0$ mm $\times \pm 5.5$ mm (hw at base). Hodoscopes are also included for measuring the angles at which electrons pass through the experimental target with resolutions in both planes of better than ± 0.1 mr. These properties are achieved by a periodic beam structure which includes correction of 2nd order aberrations by means of sextupoles. The yield of electrons is estimated to be $\approx 10^8/10^{13}$ incident protons when the energy of the electrons is about one half the energy of the protons. It is emphasized that synchrotron radiation by electrons in the beam transport magnets is very significant in reducing pion contamination of the final beam spot. It is shown that superconducting magnets to enhance this effect are superfluous. Pion impurity is $\leq 0.01\%$ at every energy and may be made essentially zero at energies greater than 160 GeV. The beam is designed with four focussing stages, the first two of which provide a beam spot of sufficient quality for tagged photon experiments. (auth)

25410 CONCEPTUAL STUDY OF A 300 MeV PION CHANNEL FOR TRIUMF. Reeve, P. A. (Univ. of Victoria, B. C.). Nucl. Instrum. Methods; 107: No. 2, 269-277(1973).

Secondary pion channels with good resolution and acceptance are discussed. Various methods of separating pions from protons at small angles are compared including a novel technique which uses a quadrupole septum magnet combination. (auth)

25411 DESIGN STUDY FOR SPLIT BEAM OPERATION OF THE INDIANA UNIVERSITY CYCLOTRON FACILITY. Pollock, R. E.; Friesel, D. L.; Devins, D. W. (Indiana Univ., Bloomington). AIP (Amer. Inst. Phys.) Conf. Proc.; No. 9, 393-398(1972).

From 6th international cyclotron conference; Vancouver, B. C. (18 Jul 1972).

See CONF-720717-.

Some of the design considerations are described for a beam transport system which will permit operation of two experiments concurrently with the external beam of the Indiana University Cyclotron Facility. Beam division by time slicing of the rf pulse microstructure can give widely spaced pulses to a time-of-flight experiment while allowing an experiment not sensitive to the missing pulses to proceed at only slightly reduced intensity and duty factor. Beam division by separation of the horizontal emittance bundle into two parts can give to two users a beam of half intensity with improved quality for high resolution experiments and an unaltered duty factor. The beam line design must be able to act upon the small deflections achieved by electrical separation devices at intermediate energies to produce very different beam paths. A design which will permit operation on split beam mode in the future with no significant increase in the initial capital cost is presented. (auth)

25412 JUELICH DOUBLE-MONOCHROMATOR SYSTEM. Reich, J. (Kernforschungsanlage, Juelich, Ger.); Mayer-Boericke, C.; Martin, S.; Brown, K. L.; Johnson, F. E. AIP (Amer. Inst. Phys.) Conf. Proc.; No. 9, 407-414(1972).

From 6th international cyclotron conference; Vancouver, B. C. (18 Jul 1972).

See CONF-720717-.

The Juelich double-monochromator system has been brought into operation at the Juelich Isochronous Cyclotron. The results of the ray tracing calculations as well as the tests with the cyclotron beam show that it has a momentum resolution power $R = p_0/\Delta p_{FWHM} = 20{,}000$ and a transmission of about 2% for 1 mm slit-width settings at the entrance and the exit of the system. These values are obtained for a horizontal and a vertical emittance of 20 and 25 mm · mrad, respectively, and a momentum bin width of 1.5/1000 of the cyclotron beam. (auth)

25413 DESIGN OF A NEUTRON THERAPY FACILITY FOR A 30-INCH CYCLOTRON. Kuchnir, F. T. (Argonne Cancer Research Hospital, Chicago); Skaggs, L. S.; Elwyn, A. J.; Mooring, F. P.; Frigerio, N. A. AIP (Amer. Inst. Phys.) Conf. Proc.; No. 9, 638-645(1972).

From 6th international cyclotron conference; Vancouver, B. C. (18 Jul 1972).

See CONF-720717-.

A Monte Carlo computer code was used to optimize the collimator and shielding design for a proposed fast-neutron therapy facility. Using time-of-flight techniques, neutron energy spectra were obtained at various angles to provide an accurate input for the computations. Measurements were made on thick beryllium targets at bombarding energies of 8.3 and 16 MeV for the deuteron beam, and at 14.8 MeV for the proton beam. On the basis of energy, angular distribution, and relative yields, the $^{9}Be(d,n)$ reaction appears to be by far more favorable than the $^{9}Be(p,n)$ reaction for neutron therapy. The beam contamination due to scattering in the collimator was computed for a polyethylene collimator of simple design. Several shielding configurations were investigated, leading to a greatly simplified room shielding design. (auth)

25414 SOME EDDY CURRENT EFFECTS IN SOLID CORE MAGNETS. Halbach, K. (Univ. of California, Berkeley). Nucl. Instrum. Methods; 107: No. 3, 529-540(1973).

A summary of a part of the work done on eddy current effects that were considered important for the design and operation of the LASL High Resolution Spectrometer (HRS) magnets is presented. Analysis of eddy currents in solid core magnets shows that for the two extremes of large and small field level changes, very different consequences of the eddy current are of concern for the user. It is shown that in the former case, irreproducibility and deterioration of magnet performance can be caused by the eddy currents, and it is indicated what steps can be taken to prevent this from occurring. In the latter case, the main concerns are field inhomogeneities that decay with time. This may necessitate long waiting periods before the magnet can be used again to its full capability, and it is shown how that waiting time can be reduced. (auth)

PHYSICS (ASTROPHYSICS AND COSMOLOGY)

Refer also to abstract 25836.

Cosmic Radiation

Refer also to abstracts 24663, 24670, and 25822.

25415 HADRONIC SCALING AND RATIOS OF COSMIC-RAY COMPONENTS IN THE ATMOSPHERE. Garraffo, Z. (Ciudad Univ., Buenos Aires); Pignotti, A.; Zgrablich, G. Nucl. Phys., B; B53: No. R 366-394, 419-428(26 Feb 1973).

Using the scaling hypothesis of hadronic inclusive reactions at high energy and data from accelerators ratios of cosmic-ray components in the atmosphere are computed. For the μ^+/μ^- ratio at sea level it is found that the inclusion of nuclear effects results in a better agreement with experimental data. In the case of the $(\pi^+ + \pi^-)/p$ ratio, a value at high energy is predicted that is considerably larger than the one usually inferred from lower energy data. (auth)

25416 PRODUCTION OF ^{26}Al IN Fe AND Si BY PROTONS AT 0.6 AND 24 GeV. Regnier, S. (CEN, Bordeaux); Lagarde, M.; Simonoff, G. N.; Yokoyama, Y. Earth Planet. Sci. Lett.; 18: No. 1, 9-12(Feb 1973). (In French).

Cross sections for ^{26}Al formation in iron and silicon targets bombarded with 0.6 and 24 GeV protons were measured by using highly selective chemical separation and $\gamma-\gamma$ spectrometry. The cross sections for iron are in mb: 0.4 ± 0.1 at 0.6 GeV, 2.5 ± 0.4 at 24 GeV; for silicon 12.6 ± 1.9 at 0.6 GeV, 6.4 ± 1.4 at 24 GeV. These values are used in order to fit the excitation function Fe(p,X)^{26}Al, of great astrophysical interest, by analogy with known equivalent nuclear reactions. (auth)

25417 STUDIES OF THE THERMOLUMINESCENCE OF THE SAINT-SEVERIN METEORITE. Valladas, G. (CEN de Saclay, Gif-sur-Yvette, France); Lalou, C. Earth Planet. Sci. Lett.; 18: No. 1, 168-171(Feb 1973). (In French).

To attempt to obtain by thermoluminescence measurements the irradiation age of the Saint-Séverin meteorite, a study of its natural and artificial thermoluminescence was done. The calibration curves indicated that, owing to the irradiation age obtained by other methods, natural thermoluminescence of Saint-Séverin would be saturated. Saturation was only observed for temperatures higher than 350°C making clear that the lower temperature thermoluminescence was fading all along the meteorite life. (auth)

25418 ENERGY DEPENDENCE OF PRIMARY COSMIC RAY NUCLEI ABUNDANCE RATIOS. Meneguzzi, M. (CEN de Saclay, Gif-sur-Yvette, France). Nature (London) Phys. Sci.; 241: No. 109, 100-101(29 Jan 1973).

Recent measurements of cosmic-ray chemical composition between 1 and 100 GeV per nucleon have shown a decrease of the abundance ratios of secondary to parent nuclei above about 10 GeV, suggesting that above this energy the mean path length of cosmic rays decreases with increasing energy. These measurements also show an energy dependence for the primary abundance ratios, and give support to charge dependence of the mean path length or of the source spectral index. Details are given of expected and measured abundance ratios for CO/Fe Ni, He/Fe Ni, and He/CO. The results appear to imply poor confinement of cosmic rays in the Galaxy at ≃100 GeV. (UK)

25419 CHARGE DEPENDENCE OF THE ENERGY SPECTRA OF COSMIC RAYS. Ormes, J. F.; Balasubrahmanyan, V. K. (Goddard Space Flight Center, Greenbelt, MD). Nature (London) Phys. Sci.; 241: No. 109, 95-96(29 Jan 1973).

New experimental results in the energy range 3 to 50 GeV per nucleon are given which indicate that the well-known enrichment of heavy nuclei in cosmic rays is increasing with increasing energy. Measurements were made with a balloon-borne ionization spectrometer, and comprised particle charge, trajectory, and energy. Spectral data are tabulated, and it is stated that at these energies solar modulation effects should be small and the spectra should reflect those in interstellar space; if these spectra continue to higher energies Fe will become the most abundant nucleus, besides protons and helium, at ~200 GeV. It is believed that the enhancement of Fe nuclei at high energies is due to effects occurring at cosmic-ray sources. It is concluded that the source spectra of heavy nuclei are flatter than those of lighter nuclei, and if all cosmic rays come from the same source then preferential acceleration of heavy nuclei is implied. It does not seem that a Z-dependent injection process can explain the data as the enhancement is most pronounced at energies well beyond any possible injection energy. The results would suggest a Z dependence of the acceleration process itself. Another possibility is that the spectral differences are due to different sources, and that the Fe nuclei are produced in closer sources with flatter spectra. (UK)

25420 MEAN PATH LENGTH OF HIGH ENERGY GALACTIC COSMIC RAYS IN THE GALACTIC DISK. Audouze, J.; Cesarsky, C. J. (California Inst. of Tech., Pasadena). Nature (London) Phys. Sci.; 241: No. 109, 98-100(29 Jan 1973).

It has been shown that the ratio of galactic secondary to primary nuclei decreases very steeply when the energy is above 30 GeV per nucleon, and it has been suggested that this effect may be explained in terms of particle propagation in the Galaxy; the leakage term that describes the probability that galactic cosmic rays leave the Galaxy must be energy dependent. A quantitative estimation of this dependence is made and the implications of such a dependence are discussed. Calculated path lengths, if confirmed would be a serious blow to the theories of disk confinement of cosmic rays, and the fluxes of secondary elements determined at such high energies are of great help in distinguishing between models of disk confinement and halo confinement. A reasonable extrapolation of the observations, if the high-energy cosmic rays are galactic, is that they are trapped in regions much larger than the galactic disk; otherwise it is possible that these high-energy cosmic rays are of extragalactic origin. (UK)

25421 LATERAL DISTRIBUTION OF UHF RADIO EMISSION ASSOCIATED WITH COSMIC RAY SHOWERS. Fegan, D. J.; O'Neill, P. P. (University Coll., Dublin). Nature (London) Phys. Sci.; 241: No. 111, 126-127(12 Feb 1973).

Measurements had been made previously on the lateral distribution of radio emission from cosmic-ray showers in the frequency band 22.25 to 178 MHz. Results showed that near the air shower core the radio pulse amplitude falls off rapidly with distance, the distribution at distances >100 m being flatter. It was also found that the lower the observational frequency the broader the lateral distribution for a given shower. An extension of these studies at two different uhf frequencies is here reported, and a small core detecting array built for the purpose is described; this comprised five plastic scintillation counters, with an oscilloscope for displaying the outputs, and two helical antennae located at the center of the array. The system frequencies were 414 and 550 MHz. The array was located at ground level at the Dunsink Observatory in Dublin. Details are given of the analytical procedure employed. (UK)

25422 HIGH-ENERGY ATMOSPHERIC MUONS IN THE MONT BLANC TUNNEL. Maeda, K. (CERN, Geneva). Nuovo Cim.; 13B: No. 2, 201-216(11 Feb 1973).

The intermediate vector boson (IVB) with a rest mass of 37.3 GeV/c^2 has been postulated recently in theoretical efforts to unify the field of weak interaction and that of electromagnetic interaction. Since the lifetime of the IVB is very short, by decay into a muon and a neutrino, the existence of this particle can be tested by measuring the deviation of the zenith-angle distribution of muon intensities produced by this particle from that of the well-known atmospheric muons produced by the decay of cosmic-ray mesons (pions and kaons). In order to show these deviations as functions of energy and of zenith angle, intensities of muons produced from the decay of cosmic-ray mesons and from that of 37.3 GeV IVB are calculated rigorously for the energy range (1 to 10) TeV, specifically for the site of the Mont Blanc tunnel where the intensities of atmospheric muons have been measured and will be extended to see these effects. It is shown that the deviations are too small to be observable, if the production cross-section of this particle is of the order of less than 0.1 mb. (auth)

25423 GALACTIC MAGNETIC FIELD IRREGULARITIES AND THEIR EFFECT ON COSMIC RAY PROPAGATION AT ENERGIES ABOVE 10^{17} eV. Osborne, J. L.; Roberts, E.; Wolfendale, A. W. (Univ. of Durham, Eng.). J. Phys., A (London); 6: No. 3, 421-433 (Mar 1973).

Astronomical data have been examined with regard to the characteristics of the irregular component of the magnetic field in the Galaxy. A model has been formulated for the irregular field, and cosmic-ray trajectories have been traced through the aggregate field. Comparison of experimental data on the arrival directions of extensive air showers with the predicted distributions shows that if the primary cosmic rays are protons then the majority between about 7×10^{17} eV and 10^{19} eV must be of extragalactic origin. Outside these limits the present arrival direction data do not allow distinction to be drawn between galactic and extragalactic origin. (auth)

25424 LONG-TERM VARIATION IN THE COSMIC-RAY DIURNAL ANISOTROPY. Iucci, N.; Storini, M. (Univ., Rome). Nuovo Cim.; 13B: No. 2, 361-378(11 Feb 1973).

The long-term modulation of the diurnal variation of the cosmic-ray intensity, observed in quiet times during the ascending phase of solar cycle number 20, is fully explained by the change in the interplanetary sector pattern. The sector structure seems to generate an upper rigidity cut-off for the diurnal variation which increases from ~50 GV during 1965 to ~150 GV during 1968. Moreover, the amplitude of the diurnal variation is reduced by a factor ~2 in periods of mixed polarities of the interplanetary magnetic field. As a consequence the North–South anisotropy seems to be completely generated by the cosmic-ray radial gradient. Estimates of the time change of this gradient from 1965 to 1968 are in agreement with those calculated from changes in the interplanetary magnetic structure. (auth)

Stars

Refer also to abstracts 25498, 25541, 25569, 25839, and 25978.

25425 NUCLEAR REACTIONS IN STARS. Kocharov, G. E. (Ioffe Inst. of Physics and Tech., Leningrad). Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 10, 2052-2065(Oct 1972). (In Russian).

The combustion of hydrogen occurs at temperatures of from 10^7 to 3×10^7°K, depending on the mass of the star, and the cycle in operation, p–p or C–N, respectively. Burning of He occurs at 10^8 to 3×10^8°K. Such nuclear reactions occur in a relatively small central region of the star, where neutrinos originate and emerge, carrying information about their formation. The importance of the reaction $^{37}Cl(\nu,e^-)^{37}A$ is discussed in relation to the changes in reaction rate as measured during the period 1959–1971. Thermonuclear reactions in the sun and the solar neutrino energy spectrum indicate that the C–N cycle may not be the fundamental source of energy release in the depths of the sun, and may contribute <5% to the sun's luminosity. Helium reactions of interest include $3\ ^4He \rightarrow\ ^{12}C$, $^{12}C + ^4He \rightarrow\ ^{16}O + \gamma$, and $^{16}O + ^4He \rightarrow\ ^{20}Ne + \gamma$. Additional nuclear reactions involve α reactions with ^{28}Si, ^{32}S, ^{36}A, ^{40}Ca, ^{44}Ti, ^{48}Cr, ^{52}Fe, and ^{56}Ni. (9 figures) (KSW)

25426 ATMOSPHERIC ABUNDANCES OF SEVEN AM SB2 SYSTEMS. Stickland, D. J. (Royal Greenwich Observatory, Eng.). Mon. Notic. Roy. Astron. Soc.; 161: No. 2, 193-211(1973).

The observed characteristics of the metallic-line A type stars are described and the theories to account for their apparent abundance anomalies are reviewed. The mounting of an observing program for the determination of the compositions of the component stars of a number of double-lined (SB2) systems and the reduction of the spectroscopic and spectrophotometric data are discussed. An account is given of a method for the determination of the atmospheric parameters and the component star luminosity ratios in SB2 systems and also of the abundance analysis procedure through the differential curve of growth. The results suggest an evolutionary origin for the metallic-line A stars and a scheme, based on the element separation mechanism, is put forward. (auth)

25427 NEAR INFRARED MAGNITUDES OF 248 EARLY-TYPE EMISSION LINE STARS AND RELATED OBJECTS. Allen, D. A. (Carnegie Institution of Washington, DC). Mon. Notic. Roy. Astron. Soc.; 161: No. 2, 145-166(1973).

Nearly 250 early-type emission-line stars have been observed in the near infrared; approximately two-thirds of these are found to exhibit excess radiation at these wavelengths. Two distinct mechanisms may contribute to the infrared excesses; thermal radiation from circumstellar dust, and electron bremsstrahlung originating in a shell of ionized gas. It is not currently possible to distinguish between these two alternatives using infrared photometry alone. (auth)

25428 GRAVITATIONAL COLLAPSE WITH CHARGE AND SMALL ASYMMETRIES. 1. Scalar Perturbations. Bicak, J. (California Inst. of Tech., Pasadena). Gen. Relativity Gravitation; 3: No. 4, 331-349(Dec 1972).

A recent analysis by Price (1973) of spherical collapse with small nonspherical perturbations is here generalized to the case of an electrically charged collapsing star ($0 < |Q| \leq M$). The perturbations are confined to a scalar field generated by a nonspherical distribution of "scalar charge" in the star. As in the electrically neutral case, the scalar perturbations are probably a prototype for all others—electromagnetic, gravitational, and higher-spin. The collapse is shown to produce a Reissner–Nordström black hole, and the scalar-field perturbations are shown to radiate completely away; but they die out more slowly the larger is the star's electric charge. For charge $|Q| < M$, the l-pole part of the perturbation at fixed r and late times is dominated by a "tail" that dies out as $t^{-(2l+2)}$. But for $|Q| = M$, the primary outgoing waves emitted from the star's surface are everywhere larger than the "tail". At fixed r and late times they die as $t^{-(l+2)}$. Also, a calculation of the redshift shows that a collapsing star becomes "black" more slowly the larger is the star's electric charge. (auth)

25429 RECENT PROGRESS IN INFRARED AND MICROWAVE TECHNIQUES OF ASTRONOMICAL INTEREST. Lena, P. (Observatorie de Paris, Meudon, France). Mem. Soc. Roy. Sci. Liege; 3: 61-81(1972).

Significant progress on almost every aspect of infrared techniques is reported: detectors, spectrometers, filters, calibration, telescopes, and imaging devices. Space systems are becoming a reality. (BE)

25430 RECENT OBSERVATIONS OF STELLER INFRARED SPECTRA. Smyth, M. J. (Univ. of Edinburgh). Mem. Soc. Roy. Sci. Liege; 3: 97-100(1972).

This is a brief progress report on observations of infrared spectra of stars, in the 1 to 4 μm region, that are being obtained by the infrared group at the Royal Observatory, Edinburgh. Work is proceeding on line identifications, and spectrum synthesis is being carried out in order to determine $^{12}C/^{13}C$ ratios from the observed CO bands. (BE)

25431 OBSERVATIONS OF INFRARED STELLAR ABSORPTION LINES. Mertz, L. (Smithsonian Astrophysical Observatory, Cambridge, MA). Mem. Soc. Roy. Sci. Liege; 3: 101-106 (1972).

Spectra of a few bright stars have been observed in the ranges 4100 to 5100 cm^{-1} and 5500 to 6400 cm^{-1} with resolution down to about 0.5 cm^{-1} in some cases. These were obtained with a standard Fourier spectrometer at the Cassegrain focus of the 1.5-m telescope at Harvard's Agassiz Station. A minicomputer served for all the data reduction. The general appearance of the spectra undergoes a conspicuous change when the molecular bands start separating into lines at somewhat finer resolution than 2 cm^{-1}. An initial tentative identification is a cluster of OH lines lying between 5912 and 5928 cm^{-1}. Spectra of R Leo and O Cet are compared with the spectra of Betelgeuse and indicate many more and stronger features blanketing the spectra of the cooler stars. (auth)

25432 INTERPRETATION OF THE 1-4μ SPECTRA OF SOME C STARS. Thompson, R. I.; Schnopper, H. W. (Massachusetts Inst. of Tech., Cambridge). Mem. Soc. Roy. Sci. Liege; 3: 107-109(1972).

The low abundance of carbon found in C stars is truly a low carbon to total gas ratio rather than a low carbon to hydrogen ratio. These observations are then quite consistent with the CNO bi-cycle predictions in which hydrogen is depleted. Coupled with the well known low $^{12}C/^{13}C$ ratios for C stars, the low carbon to total gas ratio is interpreted as strong evidence that CNO bi-cycle products determine C star atmospheric abundances. (auth)

25433 TWO-MICRON SPECTRA OF CARBON STARS. Frogel, J. A.; Hyland, A. R. Mem. Soc. Roy. Sci. Liege; 3: 111-120(1972).

Medium-resolution spectra in the two-micron region have been obtained for a representative sample of carbon variables. Observed variations in band strengths as function of color, carbon abundance, and variability type are interpreted as being due to thermal emission from a circumstellar dust shell. (auth)

25434 MOLECULAR ABSORPTION SPECTRA OF S-TYPE STARS IN THE ONE-MICRON REGION. Wing, R. F. (Ohio State Univ., Columbus). Mem. Soc. Roy. Sci. Liege; 3: 123-140 (1972).

A large number of molecular features can be studied at low resolution in the spectra of stars of type S in the near-infrared and one-micron regions (7000 to 11000 Å). In addition to the familiar bands of TiO, VO, ZrO, LaO, and CN, S-type Mira variables near minimum light show the unidentified Keenap bands (8200 to 8900 Å) and several additional unidentified features in the 9200 to 11000 Å interval. The CN bands are strong in the relatively warm S stars, and their strength and behavior is correlated with the degree of S characteristics. The discussion includes remarks on problems of spectral classification and the infrared opacities of S stars. (auth)

25435 PHOTOELECTRIC OBSERVATIONS OF RED STARS IN CYGNUS. Voelcker, K. (Kitt Peak National Observatory, Tucson, AZ); Hofmann, W.; Elsaesser, H. Mem. Soc. Roy. Sci. Liege; 3: 141-143(1972).

Photoelectric infrared photometry of red stars increasing the number of known stars with $V - K \geq 10.0$ m. Some of these stars have an infrared excess indicating circumstellar dust shells.

whereas the reddening of others can be explained by interstellar absorption. (auth)

25436 OBSERVATION OF THE OH RADICAL IN BETELGEUSE. Beer, R. (Jet Propulsion Lab., Pasadena, Calif.); Norton, R. H.; Hutchison, R. B.; Lambert, D. L.; Martonchik, J. V. Mem. Soc. Roy. Sci. Liege; 3: 145(1972).

During November and December 1969 a number of spectra of the M supergiant α Orionis was obtained in the region 2600 to 3450 cm^{-1} at a resolution of better than 0.3 cm^{-1}, apodized, using a Connes'-type Fourier spectrometer at the coudé focus of the McDonald Observatory 107'' telescope. Although this spectral region contains many hundreds of telluric absorption lines, a detailed comparison of the stellar spectrum with solar spectra taken with the same instrument shows that there are about 100 absorptions unique to the star. More than 80 of these have been identified as being due to the fundamental vibration–rotation bands of the diatomic free radical OH. (BE)

25437 $^{12}C/^{13}C$ RATIO IN THE ATMOSPHERE OF ARCTURUS. Lambert, D. L.; Dearborn, D. S. (Univ. of Texas, Austin). Mem. Soc. Roy. Sci. Liege; 3: 147-165(1972).

The abundance ratio of the carbon isotopes ^{12}C and ^{13}C in the atmosphere of Arcturus is determined from the spectra of the three molecules CH, CN, and CO. The CH A $^2\Delta-X^2\Pi$ electronic transition near 4200 Å provides several new identifications for isotopic ^{13}CH lines and a comparison of ^{12}CH and ^{13}CH line intensities yields an abundance ratio, $^{12}C/^{13}C = 6.7 \pm 1.5$. Less accurate results from analyses of the CN A $^2\Pi-X\ ^2\Sigma$ red system and the CO first and second overtone vibration–rotation bands are shown to be consistent with the CH analysis. The high ^{13}C abundance is discussed in terms of the predictions of current stellar evolution calculations. (auth)

25438 INFRARED OBSERVATIONS AND ATMOSPHERES OF COOL STARS. I. Support Mechanisms for Circumstellar Shell. Krishna Swamy, K. S.; Vardya, M. S. (Tata Inst. of Fundamental Research, Bombay). Mem. Soc. Roy. Sci. Liege; 3: 169-178(1972).

Several mechanisms have been examined to see their relative importance in maintaining the circumstellar shells around cool stars. No definite conclusion is possible about the mechanism most responsible for maintaining the circumstellar shells at the moment, due to uncertainty in the relevant physical parameters. (auth)

25439 OPACITY PROBABILITY DISTRUBUTION FUNCTIONS FOR APPLICATION TO NON-GRAY LATE-TYPE STARS MODEL ATMOSPHERES. Querci, M.; Querci, F.; Tsuji, T. (Observatoire de Paris, Meudon, France). Mem. Soc. Roy. Sci. Liege; 3: 179-186(1972).

Some comments on the introduction of the blanketing effect through opacity probability distribution functions following the Strom and Kurucz method, in late-type stars model atmospheres are given. The problem of the selection of the molecular lines of CN, C_2, and CO molecules which contribute appreciably to the opacity of carbon stars is particularly emphasized. (auth)

25440 DATA FROM OBSERVATIONS AND FROM THEORY AND PREDICTIONS CONCERNING INFRARED AND MICROWAVE SPECTRA OF NORMAL STARS, PARTICULARLY OF EARLY-TYPE STARS. Pecker, J. C. (College de France, Paris). Mem. Soc. Roy. Sci. Liege; 3: 243-292(1972). (In French).

After defending the idea that the envelope is an integral part of the atmosphere, the author refers constantly to the radiation of the envelope. The ir and radio radiations come from these external regions; a stellar atmosphere depends essentially not only on two parameters, as it has been customary to say, but on three: gravity, effective temperature, certainly, but also the state of evolution that determines the properties of the envelope in an almost exclusive manner. And for a star with a tenuous envelope, those that are called normal, there is neither noticeable or noteworthy ir radiation nor noticeable or noteworthy radio radiation—the Sun excepted, because of its proximity. The condensation that liberates the gravitational energy tends to compress the dust in the H II region in contrast with what the simplest calculations would tend to show. The dynamic problem of the ensemble, compression of dusts falling around a gaseous envelope in expansion, is a complex problem with only partial solutions. One difficulty comes from the necessity of taking into account the phenomenon of sorting which repels the smallest particles and attracts the heaviest. The dynamic problems, however complicated they are, are not the only ones. At the same time as the condensation of the protostellar mass, the central heated regions will expand. Considerations must be given to the conservation of energy, to the conservation of momentum, the electromagnetic energy, and the photon momentum. The phenomena of change of state, those that result from friction, cannot be neglected. (tr-auth)

25441 INFRARED ATOMIC SPECTRA. Moore-Sitterly, C. (Naval Research Lab., Washington, D. C.). Mem. Soc. Roy. Sci. Liege; 3: 15-34(1972).

The present state of analyses of infrared atomic spectra is reviewed for the elements H to Ni and for the lanthanide group of rare earth elements, Ce to Yb. Tables of calculated wavelengths of H(I) and He(II), and one giving recent observations of He(I) in the longwave region, are included. From Li(I) to Ni(II) the material is summarized in a table that gives for each spectrum the number of observed lines longer than 7000 Å, with the limiting wavelengths and wave numbers. The astrophysical importance of infrared atomic spectra is discussed. Examples are the radio recombination lines of H(I) observed in nebulae, the forbidden coronal and nebular lines and "expected infrared line intensities from planetary nebulae" in the range from 4μ to 25μ. Infrared observations are essential to interpret complex rare earth spectra where overlapping configurations are common features. Two independent term systems can be found in the short-wave region of a spectrum such as Ce(II) or Tb(I), but the connection can be found only in the long-wave region. Leading configurations in which f-electrons are added in the lanthanide group are described. Finally, brief mention is made of the importance of infrared atomic spectra in laser research. An extensive bibliography provides current reference material in this field. (auth)

25442 INTERPRETATION OF CONTINUUM AND LINE ABSORPTION AND RADIATION BY CIRCUMSTELLAR DUST. Greenberg, J. M.; Wang, Ru Tsang (State Univ. of New York, Albany). Mem. Soc. Roy. Sci. Liege; 3: 197-207(1972).

The procedure for calculating the extinction of starlight by dust particles must be modified when there is a substantial number of the dust particles which are within a radius about the star subtended by the reception cone of the telescope. The circumstellar particles act like a reflection nebula and a contribution of the received light is in the form of scattered radiation. Consequently the extinction efficiency of these dust particles approaches their absorption efficiency. The wavelength dependences of these two processes (extinction and absorption) are generally quite different. Several grain types and dust distributions are considered. A very important effect occurs in spectral regions where the particles are nonabsorbing because there the extinction cross section is entirely due to scattering. Thus particles whose imaginary index of refraction is small in the visual ("clean" ice or silicates) may make a negligible contribution to the visual extinction even if there is a very substantial contribution to infrared absorption or radiation. Truly circumstellar dust distributions give small polarizations. Stars with very high intrinsic polarizations may be shown in some circumstances to appear to be considerably over-luminous by as much or more than 1½ magnitudes. Absorption bands are amplified relative to extinction by circumstellar dust. (auth)

25443 KINEMATIC STUDY OF SPECTRAL FEATURES IN COOL STAR ENVELOPES. Woolf, N. J. (Univ. of Minnesota, Minneapolis). Mem. Soc. Roy. Sci. Liege; 3: 209-216(1972).

A model of gas ejection from cool stars proposed by Gehrz and Woolf has the gas ejected by collisions with dust. The dust is formed in the outermost layers of the atmosphere and accelerated by radiation pressure. This model is used to predict the spectral appearance of radio and optical spectral lines. (auth)

25444 RECENT POLARIZATION OBSERVATIONS IN THE 1.25 TO 3.6 MICRON WAVELENGTH RANGE. Forbes, F. F. (Univ. of Arizona, Tucson). Mem. Soc. Roy. Sci. Liege; 3: 217-228(1972).

Since 1967 when the NML Cygnus object was found to be polarized in the infrared wavelength (Forbes, 1967) numerous other highly reddened stars have been examined for infrared polarization. Last year, Hashimoto, Mahara, Okuda, and Sato (Hashimoto et al, 1970) found the peculiar star VY CMa to be strongly polarized at 1.6 and 2.2 microns. In this paper, some of the results of Dyck and Shawl, obtained this past year are combined with data covering a period of over five years. The most pertinent results are reported here for the 38 program stars that have been observed for polarization in the 1.25 to 3.6 μ wavelength range. (auth)

25445 OH EMISSION FROM LONG-PERIOD VARIABLE STARS. Nguyen-Quang-Rieu; Fillit, R.; Gheudin, M. (Observatoire de Paris, Meudon, France). Mem. Soc. Roy. Sci. Liege; 3: 233-237(1972).

OH emission associated with W Hya, Y Her, S CrB, and R Cas has been detected. The OH emission is concentrated in the main lines, except for S CrB. The OH maser process operating in these stars is discussed. (auth)

25446 SIMPLE PROBABILISTIC THEORY OF FRAGMENTATION. Larson, R. B. (Yale Univ., New Haven). Mon. Notic. Roy. Astron. Soc.; 161: No. 2, 133-143(1973).

A simple model for the fragmentation process in a collapsing interstellar cloud is developed, which is based on the assumption that the successive stages of the fragmentation process can be treated as random events. The resulting stellar mass spectrum predicted by the model, defined in terms of the amount of mass per unit logarithmic mass interval, is approximately a gaussian function, in agreement with the empirical initial stellar mass spectrum. Some possible ways of accounting for differences in the initial mass spectrum between different stellar systems are also discussed. (auth)

25447 ENTROPY AND BLACK-HOLE DYNAMICS. Israel, W. (Univ. of Alberta, Edmonton). Lett. Nuovo Cim.; 6: No. 7, 267-269(17 Feb 1973).

The equilibrium of a Schwarzschild black hole in the field of an external, static, axisymmetric distribution of matter (e.g. a hollow shell or concentric ring) is examined. It is concluded that it would seem reasonable to expect the entropy of the matter inside a black hole to increase without bound during the compression to a singularity, since unlimited amounts of gravitational energy are pumped into the matter and presumably thermalized. However, random fluctuations in the field must become important after a certain stage. (WDM)

25448 COLLAPSED SCHWARZSCHILD FIELDS AND THERMODYNAMICS. Basano, L.; Morro, A. (Univ., Genoa). Lett. Nuovo Cim.; 6: No. 6, 193-196(10 Feb 1973).

Recently Bekenstein (1972) analyzed the problem of the transcendence of the second law of thermodynamics in connection with black-hole physics. An attempt is made to overcome a difficulty connected with a gedanken experiment devised by Geroch (1971). Both the problem and the proposed solution are briefly summarized. (WDM)

25449 ELECTRIC CONDUCTIVITY IN THE ATMOSPHERE OF EARLY TYPE STARS. Kopecky, M.; Kotrc, P. (Astronomical Inst., Ondrejov, Czech.). Bull. Astron. Inst. Czech.; 24: No. 1, 39-49(1973).

Using the Kuklin and Nagasawa methods the values of the electric conductivity in Mihalas's models of atmospheres of early-type stars were determined. The difference between the Kuklin and Nagasawa methods in computing the electric conductivity is discussed. The electric conductivity as a function of optical depth, acceleration of gravity at the surface of the star, and of the effective temperature of the stars is also discussed, in models of Mihalas's stellar atmospheres, as well as in models of stellar atmospheres of de Jager and Neven. (auth)

25450 WEAK HELIUM-LINE STAR α SCULPTORIS. I. The Line Spectrum. Schmitt, A. (Univ., Heidelberg). Astron. Astrophys., Suppl. Ser.; 9: No. 3, 427-436(Mar 1973).

Using spectrograms with dispersions from 7 to 20 Å/mm, the spectrum of the peculiar B star αScl was investigated in the wavelength range 3170 to 7800 Å. About 400 lines could be assigned to 20 different ions of 18 elements, 26 lines remain unidentified. Equivalent widths of all lines and profiles of the strongest lines are given. From the available material no definite conclusion about spectrum variability can be derived. (auth)

25451 EJECTION OF MATTER AND GRAVITATIONAL RADIATION FROM ORBITING BODIES. Jackson, A. A. IV; Matzner, R. A. (Univ. of Texas, Austin). Nature (London) Phys. Sci.; 241: No. 112, 139-140(19 Feb 1973).

The question of a particle of mass m in circular orbit of radius r around a central body of mass $M \gg m$ is discussed. If M suddenly undergoes a decrease of mass, the orbit of m will be perturbed as the shell of emitted particles passes its radius. The matter of the escape of m and of its subsequent motion has already been discussed (Astrophys. J. 173: 665(1972) and Nature Phys. Sci. 239: 9(1972)). In the present communication related questions are considered. (UK)

25452 HEATING OF ASTROPHYSICAL PLASMA DUE TO ROTATION. Bondyopadhaya, R. (Jadavpur Univ., West Bengal, India). Czech. J. Phys.; 22: No. 11, 1199-1201(1972).

It is shown that low-frequency transverse MHD waves may undergo damping inside a rotating stellar body. It is suggested that rotation may affect the heating of the stellar interior. (auth)

25453 ADDITIONAL OBSERVATIONS OF SUPERGIANTS AND FOREGROUND STARS IN THE DIRECTION OF THE LARGE MAGELLANIC CLOUD. Brunet, J. P. (Observatoire, Marseille); Prevot, L.; Maurice, E.; Muratorio, G. Astron. Astrophys., Suppl. Ser.; 9: No. 3, 447-458(Mar 1973).

A continuation is presented of a previous work by Ardeberg et al. (1972) concerning new photometric and spectrographic data for 47 supergiants and 40 foreground stars in the direction of the Large Magellanic Cloud. V magnitudes, (B−V) and (U−B) color indices, MF spectral types, radial velocities, and remarks concerning positions, spectroscopic features, magnitudes, and colors are given. (auth)

25454 ERROR ANALYSIS OF THE PHOTOELECTRIC CATALOG. Fitzgerald, M. P. (Univ. of Waterloo, Ont.). Astron. Astrophys., Suppl. Ser.; 9: No. 3, 297-311(Mar 1973).

The data contained in the Photoelectric Catalog were analyzed in order to ascertain the internal consistency of the observations, detect transcribing errors, and detect possible variable stars. Of the 20705 stars in the catalog roughly one third have two or more observations. Of these 532 were found to have discordant results in one or more of V, B−V, U−B, or between color and spectral-luminosity class. Ten per cent of these results were caused by transcribing errors into the catalog. Sixteen percent are visual binary stars in which it is difficult to avoid either contamination or loss of light. Twenty-two percent are reasonable candidates for variability, some of which were previously known. Sixty-eight percent probably have errors in either the reported photometry (53%) or in the classification or photometry of the star (15%). The standard deviations from the mean magnitudes and colors for stars of two or more observations (excluding the discordant results) are found to be ±0.015, ±0.011, and ±0.016 m in V, B−V, and U−B respectively. Tables of the deviations by individual reference number and by spectral class are also shown. (auth)

25455 RELATIVE PROPER MOTIONS OF FAINT STARS IN THE PLEIADES. Jones, B. F. (Univ. of California, Santa Cruz). Astron. Astrophys., Suppl. Ser.; 9: No. 3, 313-345(Mar 1973).

New relative proper motions were determined for faint stars in the region of the Pleiades, including most suspected members. Membership probabilities were derived. These were used to investigate the form of the Pleiades lower main sequence. The results showed the Pleiades lower main sequence to be below both the Hyades and the sequence determined by the nearby stars. (auth)

25456 PHOTOMETRY AND CLASSIFICATION OF STARS IN SEVERAL H II REGIONS. Mayer, P.; Macak, P. (Charles Univ., Prague). Bull. Astron. Inst. Czech.; 24: No. 1, 50-51(1973).

MK spectral types and UBV photoelectric photometry are given for stars in several small H II regions. (auth)

25457 QUANTUM STATISTICAL MECHANICS OF DENSE PARTIALLY IONIZED HYDROGEN. DeWitt, H. E.; Rogers, F. J. (Univ. of California, Livermore). Phys. Earth Planet. Interiors; 6: No. 1-3, 51-59(Dec 1972).

The theory of dense hydrogenic plasmas beginning with the two component quantum grand partition function is reviewed. It is shown that ionization equilibrium and molecular dissociation equilibrium can be treated in the same manner with proper consideration of all two-body states. A quantum perturbation expansion is used to give an accurate calculation of the equation of state of the gas for any degree of dissociation and ionization. In this theory, the effective interaction between any two charges is the dynamic screened potential obtained from the plasma dielectric function. The static approximation is made; and detailed numerical calculations with the bound and scattering states of the Debye potential, using the Beth−Uhlenbeck form of the quantum second virial coefficient are carried out. The results are compared with calculations from the Saha equation; the results are found to be considerably different from the Saha results because of the proper inclusion of hydrogenic scattering states. The hydrogenic energy levels are functions of density and, as density increases, the levels move upward into the continuum, giving pressure ionization. This statistical mechanical calculation of the plasma equation of state is intended for stellar interiors; the general approach, however, seems to be suitable for extension to the calculation of the equation of state of the outer layers of large planets. (auth)

25458 PERIODIC LIGHT VARIATIONS IN HDE 226868 (CYG X-1). Lester, D. F.; Nolt, I. G.; Radostitz, J. V. (Univ. of Oregon, Eugene). Nature (London) Phys. Sci.; 241: No. 111, 125-126(12 Feb 1973).

The H_α index and the intermediate band b magnitude of the supergiant HDE 226868 were photometrically monitored for several months in 1972 using the 24 in. Pine Mountain observatory telescope. No significant variations were detected in the photometric H_α index, but changes of 0.07 were observed in the b magnitude for which the minima coincide with the spectroscopic phases of conjunction as given by radial measurements. The absence of optical variation is explained by coincidence of the measurements with the two minima. The observations of the photometric H_α index do not reflect the variability of H emission, which initially motivated the search for photometric variability. (UK)

25459 DELAYED NEUTRONS IN THE FINAL STAGE OF THE REPROCESS. Kodama, T. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro); Takahashi, K. Notas Fis., Cent. Brasil. Pesqui. Fis.; 19: No. 6, 183-191(1972).

The gross theory of beta decay is applied to the r-process calculation. In particular, it is explicitly shown that the delayed neutron emissions in the final stage of the r-process smooth out the abundance curve significantly. (auth)

25460 FIVE-COLOR OBSERVATIONS OF THE SHORT-PERIOD PULSATING STAR DELTA DEL. Van Genderen, A. M. (Leiden Southern Station, Broederstroom, South Africa). Astron. Astrophys., Suppl. Ser.; 9: No. 2, 149-156(Feb 1973).

A discussion is presented of photoelectric five-color observations of the δ Scuti stat δ Del of which the period is 0.135d. It is likely that the star belongs to the group of short-period variables with two or more periods of oscillations. It was however not possible to determine these periods, because of too few available observations. (auth)

25461 PHOTOELECTRIC FIVE-COLOR OBSERVATIONS OF W SERPENTIS. Van Genderen, A. M. (Leiden Southern Station, Broederstroom, South Africa). Astron. Astrophys., Suppl. Ser.; 9: No. 2, 157-161(Feb 1973).

Photoelectric five-color observations of the eclipsing variable W Serpentis made in three nights are presented and discussed. Part of the observations were made during the international campaign of 1966. (auth)

25462 PHOTOELECTRIC UBV PHOTOMETRY IN FOUR AREAS OF INTERMEDIATE-HIGH GALACTIC LATITUDE. Ardeberg, A. (European Southern Observatory, Santiago de Chile); Saerg, K.; Wramdemark, S. Astron. Astrophys., Suppl. Ser.; 9: No. 2, 163-181(Feb 1973).

Results of photoelectric UBV photometry for a total of 127 stars are presented. The stars observed are situated in four fields with galactic latitudes between +55° and +59°. Preliminary analysis of the results shows the stars to be predominantly of spectral type F and later. Giant stars and Pop. II stars seem to be well represented. The interstellar absorption is generally quite weak. (auth)

25463 Hα-EMISSION STARS IN AND NEAR NGC 7000. Welin, G. (Uppsala Astronomical Observatory). Astron. Astrophys., Suppl. Ser.; 9: No. 2, 183-197(Feb 1973).

A region in Cygnus comprising NGC 700 and IC 5070 was searched for Hα-emission stars on objective-prism plates obtained with the Uppsala–Kvistaberg Schmidt telescope. Altogether 141 stars of this catagory were found, 35 of which were previously known. For various reasons several of the previously known Hα-emission stars in the region escaped detection on this occasion. In the catalog are listed positions (1950.0), V and B magnitudes, Hα intensities and, where known, spectral types. Stars of special interest are discussed in the text. (auth)

25464 EQUIVALENT WIDTHS FOR γ CAP AND THE STANDARD 30 L Mi. Selvelli, P. L. (Astronomical Observatory, Trieste, Italy). Astron. Astrophys., Suppl. Ser.; 9: No. 2, 199-207(Feb 1973).

A list of the identifications and of the equivalent widths for the A peculiar star γ Cap and the comparison standard 30 L Mi is presented. (auth)

25465 LINE DISPERSION FUNCTION FOR ENHANCED DAMPING. Wittmann, A. (Univ., Goettingen, Ger.). Astron. Astrophys., Suppl. Ser.; 9: No. 2, 209-212(Feb 1973).

In analogy to the Taylor series expansion of the line dispersion function F(a,v) for small damping parameter a (similar to that of the related Voigt function), an approximation of F(a,v) for large a is provided in order to facilitate frequent computations of that function. (auth)

25466 MEMBERSHIP OF THE OPEN CLUSTER NGC 6633. Sanders, W. L. (Yerkes Observatory, Williams Bay, WI). Astron. Astrophys., Suppl. Ser.; 9: No. 2, 213-220(Feb 1973).

Probabilities of membership based on relative proper motions for 497 stars in the field of NGC 6633 are given. The cluster proper motion dispersion (m.e.) of 0.0007″ yields 113 probable members. (auth)

25467 MEMBERSHIP OF THE OPEN CLUSTER NGC 6913 (M29). Sanders, W. L. (Yerkes Observatory, Williams Bay, WI). Astron. Astrophys., Suppl. Ser.; 9: No. 2, 221-227(Feb 1973).

Probabilities of membership, based on relative proper motions for 228 stars in the field of NGC 6913, are given. The cluster proper motion dispersion (m.e.) of 0.0025″ yields 92 probable members. (auth)

25468 OPEN CLUSTER NGC 2527. Lindoff, U. (Lund Observatory, Sweden). Astron. Astrophys., Suppl. Ser.; 9: No. 2, 229-232(Feb 1973).

Photographic magnitudes on the UBV system based on a photoelectric sequence were determined for stars in NGC 2527, designed as an open cluster. Spectral classes were determined for the brightest stars from slit spectra and objective prism plates. NGC 2527 seems to consist of about 25 stars, all of them brighter than V ≈ 13m. The brightest stars show spectral classes A2–A8, and NGC 2527 is likely to be a real cluster. The color excess, E_{B-V} in front of the cluster is about 0.1m and the distance 550 pc. (auth)

25469 PHOTOMETRIC STUDY OF THE OPEN CLUSTER NGC 2516. Feinstein, A.; Marraco, H. G.; Mirabel, I. (Univ. Nacional, La Plata). Astron. Astrophys., Suppl. Ser.; 9: No. 2, 233-250(Feb 1973).

104 stars were observed in the UBV system, of which 28 and 23 were also in the RI and Hβ system, respectively. It was found that the dispersion of the observed color excesses is almost completely due to the intrinsic color dispersion rather than by that of the true excess. This was shown by means of an angular autocorrelation analysis. A corrected modulus of 8.00 ± 0.20 m and an age of 6×10^7 years were obtained by treating the data with a mean color excess $\bar{E}_{B-V} = 0.12$m. All the peculiar stars observed by Abt and Morgan (1969) were found to be members. The relative position of the brightest star, which is of Be-type, in the color–magnitude and color–color diagrams is the same as in other clusters of the same age. (auth)

25470 PHOTOMETRIC STUDY OF THE GALACTIC CLUSTER NGC 2335. Claria, J. J. (Univ. Nacional, Cordoba, Argentina). Astron. Astrophys., Suppl. Ser.; 9: No. 2, 251-260(Feb 1973).

The galactic cluster NGC 2335, situated in the northern part of the irregular H II region S296 (Sharpless 1959), was investigated photometrically. Photoelectric results (UBV) are presented for 60 stars down to V = 14.0 m. A mean color excess E(B–V) = +0.40, corresponding to visual absorption of 1.20m was found and no marked variation in reddening across the cluster was detected. A minimum membership of 19 stars, including two possible giant members was confirmed. The true distance modulus and the distance were found to be 10.05 m and 1020 pc respectively. An age of 1.5×10^8 years from the turn off point on the main sequence was found. It is suggested that the open clusters NGC 2335 and NGC 2343 are members of a double system connected with the H II region S296 and the Canis Majoris OB 1 association. (auth)

25471 THREE COLOR PHOTOMETRY OF THE FIVE OPEN CLUSTERS NGC 7039, NGC 7062, NGC 7067, NGC 7082, IC 1369. Hassan, S. M. (Univ., Basel). Astron. Astrophys., Suppl. Ser.; 9: No. 2, 261-287(Feb 1973).

The application of the method of three color UBV-photometry to the five open clusters NGC 7039, NGC 7062, NGC 7067, NGC 7082, and IC 1369 lead to new distance determinations of these objects. Considerations on age and membership as well as other cluster parameters are discussed. NGC 7067 is confirmed to be a young open cluster located at the +1 spiral arm. The other clusters have been found to be too old for spiral arm indicators. (auth)

25472 NEUTRON RADIATIVE-CAPTURE CROSS-SECTIONS FOR (S PROCESS) CALCULATIONS IN STARS. Benzi, V.; D'Orazi, R.; Reffo, G. (Comitato Nazionale Energia Nucleare, Bologna). Nuovo Cim.; 13B: No. 2, 226-248(11 Feb 1973).

An estimate of the effective neutron cross sections for a number of nuclei involved in the s-process in stars is given. The effective cross sections were obtained as weighted averages of neutron radiative-capture cross sections over Maxwellian energy distributions at various temperatures. The semi-empirical method adopted for the calculation of the energy-dependent cross sections is outlined. The effective cross sections are given in tabular form for KT ranging from 0.01 to 0.1 MeV. (auth)

25473 PLASMA PERTURBATION AS A POSSIBLE MECHANISM OF MASS LOSS FROM HOT STARS. Basu, B.; Bandyopadhaya, R. (Jadavpur Univ., Calcutta). Indian J. Phys.; 46: No. 11, 513-520(Nov 1972).

The rate of mass loss from hot stars has been calculated with the linearized macroscopic plasma perturbation theory. Numerical estimates of the loss rates have been made for Be stars, hot supergiants, and Wolf–Rayet stars. The rates calculated with the theory are, in general, less than those of the observed results and have good agreement with some theoretical results of other authors. Particularly, if hot extended envelopes are assumed to exist surrounding these stars, high mass loss rates, of the order of 10^{-7} $M_\odot\,yr^{-1}$, are obtained. (auth)

25474 CONDITIONS FOR THE PRODUCTION OF PROMETHIUM IN STELLAR ATMOSPHERES. Tjin A Djie, H. R. E. (Univ., Amsterdam); Takens, R. J.; van den Heuvel, E. P. J. Astrophys. Lett.; 13: No. 4, 215-220(Apr 1973).

Physical conditions for the production of promethium in rare-earth-rich stellar atmospheres have been examined. Production by the spontaneous fission of superheavy elements sets very strong requirements on the time elapsed since the superheavy elements were formed. It appears that reactions of flare-accelerated particles with neodymium offer a more likely mechanism for the production of observable quantities of Pm. The requirements of observability of Pm yield a lower limit for the required fluxes. An upper limit can be estimated from photometric observations since energy dissipation of large particle fluxes will increase the atmospheric temperature. These limits are discussed for HR 465 and for certain S-type stars for which possible identifications of Pm have been given. (auth)

Quasi-Stellar, Radio, and X-Ray Sources

Refer also to abstracts 25458 and 25551.

25475 ALL STATIONARY, BIFURCATE, ELECTROVACUUM HORIZONS WITH AXIAL SYMMETRY AND TOPOLOGY $S^2 \times R^1$. Hajicek, P. (Univ., Bern). Lett. Nuovo Cim.; 6: No. 4, 157-160(27 Jan 1973).

It is stated that any perfect horizon H is a totally geodesic hypersurface so that the affine convection of the outer space-time induces a unique inner three-dimensional affine convection in H, which, together with the degenerate metric provides the bulk of the initial data. Only those results are described which allow a brief description. (W.D.M.)

25476 TWO PUZZLING OBJECTS: OJ 287 AND BL LACERTAE. Stull, M. A. (Stanford Univ., Ca.). Sky Telesc.; 45: No. 4, 224-226(Apr 1973).

The characteristics of the peculiar objects OJ 287 and BL Lacertae are discussed and attempts to classify these objects are reviewed. (WDM)

25477 DISTRIBUTION OF X-RAY SOURCES IN OUR GALAXY. Seward, F. D. (Univ. of California, Livermore). Sky Telesc.; 45: No. 4, 220-223(Apr 1973).

Soft x-ray data from two sounding rocket flights in May 1970 and May 1971 are reviewed and it is demonstrated how these results are used to map the distribution of x-ray sources in the Milky Way. (WDM)

25478 OBSERVATIONS OF 3C 129, 3C 129.1, AND 3C 83.1B AT 2.7 AND 5 GHz. Riley, J. M. (Cambridge Univ., Eng.). Mon. Notic. Roy. Astron. Soc.; 161: No. 2, 167-180(1973).

The radio sources 3C 129 and 3C 83.1B, each of which consists of a long "tail" extending away from the associated galaxy, have been mapped at 2.7 and 5 GHz with the Cambridge One-Mile telescope. In each case, the double structure previously observed near the galaxy at 1.4 GHz is found to be of considerable complexity. There is a marked increase in spectral index along the tail in 3C 129 but not in 3C 83.1B despite the apparent similarity of structure. Observations have also been made of 3C 129.1 and reveal four components, two on each side of the associated galaxy. Tables are given summarizing the characteristics of 3C 129, 3C 83.1B, IC 310, and 5C 4.81, and of the compact radio galaxies with which they may be physically associated. (auth)

25479 RADIO SOURCES IDENTIFIED WITH STELLAR OBJECTS USING PRECISE RADIO AND OPTICAL POSITIONS. Gent, H.; Crowther, J. H.; Adgie, R. L.; Hoskins, D. G.; Murdoch, H. S.; Hazard, C.; Jauncey, D. L. (Royal Radar Establishment, Malvern, Eng.). Nature (London); 241: No. 5387, 261-263(26 Jan 1973).

It is stated that, while it is difficult to establish the identification of a radio source with an object of stellar appearance and neutral color, such identifications can be made by comparing radio and optical positions of accuracy better than 1 arc s. The Royal Radar Establishment interferometer was used to measure the positions of some radio sources at 2695 MHz, with a typical accuracy of ~0.5 arcsec rms in each coordinate; these sources had radio angular extents <10 arcsec and were nearly all stronger than 0.4 fu at 2695 MHz. A comparison was made of the positions of the optical objects noted earlier with the RRE radio positions, and this led to some revision of the earlier identifications. One of the radio sources showed a blank optical field, but the remainder was all identified with optical objects. Only one source showed a normal spectrum and this was the only one identified with a galaxy, and a real separation is suggested between the optical and radio centroids of this source. (UK)

25480 SEARCH FOR HIGH FREQUENCY OPTICAL PULSAR IN SUPERNOVA NGC 5253. Beresford, I. R.; Greenhill, J. G.; Hamilton, P. A.; Watson, R. D. (Univ. of Tasmania, Sandy Bay, Australia). Nature (London) Phys. Sci.; 241: No. 111, 126(12 Feb 1973).

It has been suggested that because of high initial luminosities pulsars associated with extragalactic supernovae may be optically detectable a few months subsequent to the supernova explosion. The discovery of a bright supernova in NGC 5253 provided a good opportunity to test this hypothesis. Observations of this supernova were made with a pulse counting photometer attached to the Tasmania 40 cm telescope, during June to September 1972. These consisted of continuous white light pulse trains of up to 1 k duration recorded on magnetic tape. The records were analyzed for predictions in the frequency range up to 1 kHz—no significant periodicities were observed in this frequency range. (UK)

25481 EVIDENCE FOR DIFFERENCES IN THE ENERGY SPECTRA OF COSMIC RAY NUCLEI. Webber, W. R.; Lezniak, J. A.; Kish, J. C.; Damle, S. V. (Univ. of New Hampshire, Durham). Nature (London) Phys. Sci.; 241: No. 109, 96-98(29 Jan 1973).

It is stated that the existence of differences in the energy spectra of cosmic-ray nuclei at energies $\gtrsim 1$ GeV per nucleon would have important implications for their method of acceleration and their propagation in interstellar space, but only recently has it been possible to isolate and compare the spectra of particular charges or charge groups with the requisite statistical accuracy over a broad enough energy range. It seems natural to expect that any spectral differences would be greatest for charges or charge groups widely separated in Z. As charge measurements have improved it has been recognized that about half of the VH group nuclei are nuclei with Z = 20 to 25, and current models of cosmic-ray propagation suggest that these are "secondary" nuclei produced by the fragmentation of Fe and Ni in interstellar hydrogen, only the Fe and Ni being mostly "primary" or cosmic-ray source nuclei. In order to look for possible spectral differences, perhaps related to the acceleration process in the cosmic-ray sources, it seems appropriate to compare ratios of mainly primary nuclei such as He, C + O, and Fe + Ni. Data on the intensities of these nuclei at several energies from ~1 to 50 GeV are tabulated, together with the integral C + O/Fe + Ni as a function of energy; the He/Fe + Ni ratio shows a similar behavior. The reason for the differences in spectra are discussed; an immediate conclusion might be to relate them to possible acceleration effects in the cosmic-ray sources, but under some circumstances they may be caused by propagation effects. (UK)

25482 21-CM ABSORPTION SPECTRUM IN FRONT OF CYGNUS X-3. Lauque, R.; Lequeux, J.; Nguyen-Quang-Rieu (Observatoire de Paris, Meudon, France). Nature (London) Phys. Sci.; 241: No. 109, 94-95(29 Jan 1973).

Reference is made to the authors' previous observations (Nature Phys. Sci. 239: 119(1972)), made with the Nancay radiotelescope, on the 21 cm absorption spectrum in front of the highly variable radio source believed to be associated with Cygnus X-3 and it is stated that in a region showing large variations in the 21 cm emission, such as the surroundings of Cyg X-3, the procedure may have involved large uncertainties due to an insufficient knowledge of the HI emission at the location of the source. In the case of strongly variable radio sources, however, an absorption spectrum free of these uncertainties can be derived from observations at two epochs at which the fluxes are widely different. Some good comparison observations have recently been obtained, after the source had become indistinguishable from the surrounding galactic background, and some changes to the earlier results are given. From a comparison between the emission and absorption spectra it was calculated that the distance of Cyg X-3 is at least 11 kpc. Also from these spectra a revised value for the column density of atomic H in front of Cyg X-3 was obtained. Brief reference is also made to OH and H_2CO line observations of Cyg X-3. (UK)

25483 RECENT OBSERVATIONS OF CYG X-3 AT 365 MHz. Bash, F. N.; Ghigo, F. D. (Univ. of Texas, Austin). Nature (London) Phys. Sci.; 241: No. 109, 93-94(29 Jan 1973).

Following announcement of the discovery of the great radio flare in Cyg X-3 this object was observed at 365 MHz using the Broadband Synthesis Interferometer at the University of Texas Radio Astronomy Observatory. The observations consisted of flux density and position measurements and were made over the period September 6 to October 10, 1972. The flux density rose linearly to a peak

on September 30, probably exceeding 8 ft, and then fell as a power law in time. The observations were compared with the predictions of a simple model, such as an adiabatically expanding cloud of relativistic electrons, after fitting the model with data obtained earlier at 8085 and 2695 MHz, in order to predict what should have been observed at 365 MHz. Predictions of van der Lann's model (Nature 211: 1131(1966)) are also discussed and found not to describe the radio flares in Cyg X-3. (UK)

25484 INTENSITY VARIATIONS IN A COMPLETE SAMPLE OF RADIO SOURCES AT 2300 MHz. Nicolson, G. D. (National Inst. for Telecommunications Research, Pretoria). Nature (London) Phys. Sci.; 241: No. 109, 90-92(29 Jan 1973).

Studies of a statistically complete sample of radio sources show that variable sources form a significant component of the strong radio source population above 1400 MHz. (auth)

25485 BL LAC: STRONG SHORT-TERM VARIABILITY. Weistrop, D. (Tel Aviv Univ., Israel). Nature (London) Phys. Sci.; 241: No. 113, 157-158(26 Feb 1973).

Photoelectric magnitudes were obtained for this object in December 1972, using the 40 inch telescope at the observatory. The results indicated larger short term changes in magnitude than hitherto observed for BL Lac. The detection system consisted of a two-channel photoelectric photometer mounted at the Cassegrain focus. Results are shown plotted. Systematic changes of 1.5 mag were indicated in some cases over periods of approximately one hour. The observations indicated flux changes by a factor of 4 over short periods, and may imply very violent activity. (UK)

25486 CONFIRMATION OF I ZW 1727 + 50 AS A RADIO SOURCE. Argue, A. N. (Cambridge Univ., Eng.); Kenworthy, C. M.; Ryle, M.; Shakeshaft, J. R. Nature (London) Phys. Sci.; 241: No. 112, 139(19 Feb 1973).

Radio emission has been detected at 4.85 GHz from a source which it is suggested may be associated with I Zw 1727 + 50 (I Zw 187), one of Zwicky's compact blue galaxies. Both the optical and radio features indicate that it is an object of the BL Lac(VRO 42.22.01) class. More accurate positional measurements at optical and radio wavelengths are here reported; these agree closely and confirm the association. (auth)

25487 POSITION OF PSR 0833-45. Vaughan, A. E.; McAdam, W. B. (Univ. of Sydney). Nature (London) Phys. Sci.; 241: No. 112, 138-139(19 Feb 1973).

Accurate positions have been reported for the pulsar PSR 0833-45 using both a timing method and an interferometer but these positions differ by 14 arc s. A series of accurate measurements has been carried out at the Molongo Radio Observatory during the period September 1971 to November 1972 in an attempt to resolve this discrepancy. (auth)

25488 EFFECT OF THE AVAILABILITY OF SEARCH LINES IN DETERMINING QSO EMISSION LINE REDSHIFT DISTRIBUTION. Basu, D. (Univ. Mackenzie, Sao Paulo, Brazil). Nature (London) Phys. Sci.; 241: No. 113, 159-160(26 Feb 1973).

It is stated that the search lines used for determining the redshifts of QSOs are distributed nonuniformly in the uv and visible part of the spectrum, and a study is described of the effect of available search lines on the distribution of QSO emission line redshifts. Twenty-three lines were found to be normally observed and used for redshift measurements; these are listed. It was found that more QSOs have been observed at redshift intervals where there are more search lines available for redshift measurement, and the analysis shows that the availability of search lines at various redshifts has an appreciable effect on the distribution of QSO emission line redshifts. (UK)

25489 CHAIN OF RADIO SOURCES NEAR 4C 19.15. Andrew, B. H.; Ehman, J. R. (National Research Council of Canada, Ottawa). Nature (London) Phys. Sci.; 241: No. 113, 158(26 Feb 1973).

A chain of six radio sources has been reported, consisting of 4C 19.15, PKS 0531 + 19 and four previously unknown sources. If these sources are physically associated, rather than randomly juxtaposed, such an association would be very relevant to the argument that quasars are anomalous objects that have been ejected from nearby galaxies. The four new sources have not been optically identified, but PKS 0531 + 19 is identified with a 17.7 mag E-type galaxy. All of the sources in the chain have angular diameters $\leq$10 arc s, and it seemed of interest to measure their flux densities in the microwave region. The spectra had normal spectral indexes typical of radio galaxies. No additional evidence was found for any physical association among the sources. The observations were made at 3100 MHz with the 150 ft. telescope of the Algonquin Radio Observatory, the receiver being a liquid nitrogen cooled parametric amplifier. Positions, flux densities at 3100 MHz, and spectral indexes are shown tabulated. (UK)

25490 HARD X-RAY EMISSION FROM UHURU SOURCES. Manchanda, R. K.; Sreekantan, B. V. (Tata Inst. of Fundamental Research, Bombay). Nature (London) Phys. Sci.; 241: No. 111, 124-125(12 Feb 1973).

In two balloon flights carried out from Hyderabad in April 1969 and May 1970 a large part of the sky defined by RA = 190° to 330° and δ = −20° to +50° was scanned for hard x-ray emission in the 16 to 150 keV band, the results for which have already been published. The present authors re-analyzed the data from the first flight in order to obtain information on the spectral characteristics of the observed sources, the results of which are shown tabulated. Some comments are also included on data analysis of the second flight. (UK)

25491 RELATIVISTIC PLASMA AND PULSAR EMISSION MECHANISMS. Kaplan, S. A. (Gorky State Univ., USSR); Tsytovich, V. N. Nature (London) Phys. Sci.; 241: No. 111, 122-124(12 Feb 1973).

It is stated that from the two established facts of pulsar emission, namely, that the density of the energy flux from 1 cm^2 of the surface of the emitting region is extremely large, and that the maximum effective temperature of radio emission also reaches very large values, it follows that the plasma in the emitting region must be ultrarelativistic, this expression referring to the case when the mean energy of all plasma particles, or at least of one component (for example, all electrons), is much larger than their rest energy mc^2. The very strong magnetic field supposed to be present near pulsars changes the properties of ultrarelativistic plasma; in particular the ultrarelativistic particles rapidly lose their momentum component perpendicular to the magnetic field, and their distribution function will be nearly one-dimensional, along the magnetic field lines. An example of such a process is a synchrotron compression of electrons to the magnetic field lines. It is shown that such compression leads to new emission mechanisms having properties essentially different from those of synchrotron emission; these properties are discussed. Ultrarelativistic plasma with a high emission rate in the presence of a high magnetic field must always be turbulent, and consideration is given to the mechanisms of the high-frequency radiation of turbulent relativistic plasma in a large magnetic field. (UK)

25492 CIRCULAR POLARIZATION IN INVERSE COMPTON SCATTERING OF SYNCHROTRON RADIATION. Bonometto, S. A.; Saggion, A. (Inst. of Astronomy, Cambridge, Eng.). Astrophys. Lett.; 13: No. 4, 193-197(Apr 1973).

A simple model is used to show that inverse Compton scattering of synchrotron radiation by the very electrons that produced it leads to an emission in which the degree of circular polarization is expected to be much smaller than the degree of circular polarization of the synchrotron radiation itself. The relevance of these results in connection with recent observations of Landstreet and Angel is outlined. (auth)

25493 IDENTIFICATION OF SOUTHERN QUASI-STELLAR OBJECTS. III. Peterson, B. A. (Australian National Univ., Canberra); Bolton, J. G. Astrophys. Lett.; 13: No. 4, 187-192 (Apr 1973).

Forty new southern quasi-stellar objects were found from combined ratio and optical observations. (auth)

25494 MEAN ENERGIES OF PULSARS AT 1420 MHz. Sieber, W.; Wielebinski, R. (Max-Planck-Institut fuer Radioastronomie, Bonn). Astrophys. Lett.; 13: No. 4, 225-228(Apr 1973).

Mean pulse energies at 1420 MHz are given for 15 pulsars. The observations were made in 1971 and 1972 with a 25-m telescope; integration techniques were used to give a satisfactory signal-to-noise ratio. The results are compared with those of other authors. (auth)

25495 21-CM LINE ABSORPTION PROFILES OF PULSARS PSR 0740-28 AND PSR 1818-04. Gomez Gonzalez, J.; Guelin, M.; Falgarone, E.; Encrenaz, P. (Observatoire, Meudon, France). Astrophys. Lett.; 13: No. 4, 229-232(Apr 1973).

21-cm line spectra were determined in front of the pulsars PSR 0740-28 and 1818-04. Towards PSR 0740-28 absorption was detected up to +19.5 km/sec, and this places the pulsar at a distance of between 1.5 and 2.5 kpc from the Sun, far behind the Gum Nebula. This distance, and the dispersion measure in the direction of PSR 0740-28, lead to a mean electron density $\langle n_e \rangle \leq 0.1$ cm^{-3} along the line of sight inside the Gum Nebula. Toward PSR 1818-04, absorption is present only near to the local-standard-of-rest velocity. An upper limit of 1.5 kpc is set for its distance. (auth)

25496 MAGNETIC DIPOLE RADIATION FROM A SUPERMASSIVE OBLIQUE ROTATOR. Ozernoi, L. M.; Usov, V. V. (Lebedev Inst. of Physics, Moscow). Astrophys. Lett.; 13: No. 4, 209-214(Apr 1973).

The results are presented of a calculation of magnetic dipole (MD) radiation from a supermassive oblique rotator (SOR) with a nonnegligible contribution of radiation pressure. It is shown that the plasma flowing out from a SOR because of the rotational instability is accelerated by MD radiation up to relativistic energies. The accelerated relativistic electrons radiate by the synchrotron mechanism mainly in the far infrared region. This fact, as well as the consequences from the calculated secular change of MD radiation, allows us to explain some of the principal properties of quasars and active nuclei of galaxies. Consequences of the theory of a SOR are suggested that can serve as observational tests for its validity. (auth)

25497 OBSERVATIONS OF PULSARS AT 4850 MHz. Crovisier, J. (Observatoire, Meudon, France). Astrophys. Lett.; 13: No. 4, 221-223(Apr 1973).

Eight pulsars were observed at 4850 MHz with the Nançay radio telescope, and five of these were detected. The integrated pulse profiles are presented for four of them. (auth)

25498 LIMITS ON THE OPTICAL PULSATIONS OF HZ HERCULIS. Frohlich, A. (Tel-Aviv Univ., Israel). Astrophys. Lett.; 13: No. 4, 233-235(Apr 1973).

Two sets of observations were made to detect the optical counterpart in HZ Herculis of the 1.2-sec x-ray pulsation of Her X-1. The first set of measurements placed an upper limit of 1 percent of the optical power of HZ Her in the pulsed mode. The second set of observations placed upper limits between 0.2 and 0.8 percent of the optical power of HZ Her with pulse widths of at least 0.2 sec. (auth)

Solar Phenomena

Refer also to abstract 25568.

25499 SOLAR ACTIVITY AND XUV EMISSION. Allen, C. W.; Yousef, S. (London Univ.). Mon. Notic. Roy. Astron. Soc.; 161: No. 2, 181-191(1973).

An attempt has been made to segregate the solar activity variation of solar xuv (= x ray + euv) emission into the components: (Q) due to solar-cycle changes in the quiet Sun radiation; and (AR) due to radiation from the active regions themselves. The segregation has been achieved by making correlations with sunspot number of various observations of xuv fluxes and intensities from rockets and satellites. The various observations have been interconnected by relating wavelength bands to the temperature of emission T_C. It has been found possible to determine the coefficient of variation q and a as a function of T_C and wavelength. (auth)

25500 QUIET AND COLLISIONLESS SOLAR WIND. I. C.G.L. Approximation and the Evaporative Type Method. Fridman, M. (Univ., Liege). Bull. Soc. Roy. Sci. Liege; 41: No. 9–10, 511–520(1972).

The first order approximation of the non-collision protons expansion is the Chew, Goldberger, Low technique. The simplified 20 moments GRAD method is introduced to take into account the parallel heat flux and to extend the solution through the collision transition region. The solar wind rotation is introduced. (auth)

25501 GEGENSCHEIN OBSERVATIONS FROM PIONEER 10. Hanner, M. S.; Weinberg, J. L. (Dudley Observatory, Albany). Sky Telesc.; 45: No. 4, 217-218(Apr 1973).

A few preliminary results from the Imaging Photopolarimeter onboard Pioneer 10 concerning the skyglow and gegenschein are given. (WDM)

25502 PHYSICS OF SOLAR FLARES. Tandberg-Hanssen, E. (National Center for Atmospheric Research, Boulder, CO). Earth Extraterr. Sci.; 2: No. 3, 89-98(Feb 1973).

The flare phenomenon is discussed in the framework of the preexisting magnetic fields, and three flare components are distingushed, the "plage flare," the "prominence flare" and the "sunspot flare." In the first component the role of the magnetic field is basically passive, merely channeling energy from below to the flare region in the preexisting plage, where the energy is stored and dissipated. The energy source is the vast reservoir of the subphotospheric turbulent convection. In "prominence flares" the role of the magnetic field is a supporting one, storing mass as gravitational potential energy in the form of quiescent prominences, as well as a triggering one for the disparition brusque. Finally, in the high-energy "sunspot flares" the magnetic field furnishes most of the energy as magnetic flux is destroyed. Some of the energy is converted to thermal energy, some is being used to accelerate particles, accounting for the high-energy aspects of these flares: impulsive radio bursts and nonthermal x rays. (auth)

25503 PHOTOSPHERIC CONVECTIVE NETWORK AS A DETERMINING FACTOR IN SUNSPOT AND GROUP DEVELOPMENT AND STABILIZATION. Bumba, V.; Ranzinger, P.; Suda, J. (Astronomical Inst., Ondrejov, Czech.). Bull. Astron. Inst. Czech.; 24: No. 1, 22-38(1973).

Using the high-resolution photographs of sunspot groups obtained at the Ondřejov Observatory, the regularities in spot distribution and forms were investigated in their relation to the supergranular network. The instrument and method of observation used, as well as the obtained observational material, are described. Three main and two secondary characteristic ("quantized") values of spot distances and diameters, which may be mutually composed in different formations, were found: 19,000, 27,000, 35,000, 46,000, and 54,000 km. It is shown that the supergranular network controls the development of practically all activity phenomena in the solar atmosphere. This speaks in favor of the very great importance of convection in activity and its magnetic field formation. (auth)

25504 SOLAR OSCILLATIONS AT 9.6 MM. Shuter, W. L. H.; McCutcheon, W. H. (Univ. of British Columbia, Vancouver). Nature (London) Phys. Sci.; 241: No. 112, 140-142(19 Feb 1973).

Observations of solar oscillations at cm and mm wavelengths have been reported recently, presumably arising in higher levels of the chromosphere. These oscillations, in most cases, have been reported in the quiet Sun, with some enhancement of their amplitudes when active regions were observed. The observations here described were made in an attempt to study the solar oscillatory phenomena in the mid-range of other reported results ($\lambda \approx 9.6$ mm), and particular care was taken to minimize the effects of fluctuations in atmospheric absorption. A new 4.57 m Cassegrain paraboloid at the University of British Columbia was used, with a superheterodyne radiometer with a balanced Schottky barrier diode mixer. Full details are given of the technique employed. The observations showed the difficulty of carrying out ground based observations of solar oscillations at mm wavelengths, but observations made from above the atmosphere would circumvent most of these difficulties. (UK)

25505 THREE-WAVE INTERACTION IN COLD MAGNETIZED PLASMAS. Stenflo, L. (Univ. of Umeaa, Sweden). Planet. Space Sci.; 21: No. 3, 391-397(Mar 1973).

The coupled equations for the resonant nonlinear interaction between three waves in cold magnetized plasmas are derived and written in a comparatively simple and symmetric form. The deficiencies of previous data are pointed out and the possibility of explosive interactions in the solar corona is suggested. (auth)

25506 OPTICAL PROPERTIES OF SINGLE-COMPONENT ZODIACAL LIGHT MODELS. Giese, R. H. (Univ., Bochum, Ger.). Planet. Space Sci.; 21: No. 3, 513-521(Mar 1973).

To provide material for interpretations of forthcoming zodiacal light measurements the characteristics of 468 single-component, inecliptic models are summarized in two survey diagrams. The models are based on Mie theory and on a power law $dn \propto r^{-\nu}\, \alpha^{-k}\, d\alpha$ for the dependence of the particle number density n on solar distance r and on the size parameter α (circumference/wavelength). The size range involves particles with $\alpha_{min} \leq \alpha \leq 120$; ($\alpha_{min}$ = 1, 2, 4, 10, 60), flat (k = 2.5) and steep (k = 4) size spectra, and complex refractive indices $m = m_1 - m_2 i$ with m_1 = 1.33; 1.5; 1.7 and m_2 = 0; 0.01; 0.05; 0.1. The models suggest that the spatial variation of dust particle number densities should be less than about $\propto r^{-0.5}$ in the ecliptic plane. Either dielectric particles of tenth-micron size or absorbing particles of half-micron size or very slightly absorbing particles of some tens of microns in size are able to produce polarization that agrees in sign and location of the maximum with the observations. Ambiguities can only be removed by considering intensity and polarization over a wide range of wavelengths. (auth)

25507 SOME STUDIES ON THE ASSOCIATION OF SOLAR OPTICAL FLARES AND MICROWAVE BURSTS WITH SUDDEN IONOSPHERIC DISTURBANCES. Das Gupta, M. K.; Mitra, R. K.; Sarkar, S. K. (Univ. of Calcutta). J. Gupta, Terrest. Phys.; 35: No. 4, 805-813(Apr 1973).

The association of solar optical flares (numbering 8230) reported under the dual classification and also of different types of microwave bursts (numbering 1670) with the sudden ionospheric disturbances (SID's) during the peak phase of current solar cycle (cycle 20) have been examined. Important results obtained are: (1) Percentage association of flares with SID's of all types in-

creases with the intensity of the flares irrespective of their areas; (2) out of 51 flares associated simultaneously with all the six different types of SID's, 37 were of bright intensity (b), and only two were of large area (class 3); (3) microwave burst-SID association increases with the increase of pure flux. Further, percentage association is higher when the bursts are complex or contain "fluctuations"; (4) of the 47 microwave bursts associated simultaneously with all the six SID's, 83 per cent show fluctuations; (5) SFD's (sudden frequency deviations) are found to have their peaks attained earlier than those of both the associated flares and microwave bursts. Results obtained from the present investigation lead to the conclusion that a bright flare with an associated microwave burst of either complex type or having fluctuations is a true indication of the simultaneous occurrences of all the different types of sudden ionospheric disturbances. (auth)

25508 EFFECT OF MECHANICAL WAVES ON EMPIRICAL SOLAR MODELS. Ulmschneider, P. (Univ., Wuerzburg, Ger.); Kalkofen, W. Solar Phys.; 28: No. 1, 3-7(Jan 1973).

Empirical solar models contain the effect of heating due to radiative energy loss from acoustic waves. The temperature difference between the radiative equilibrium model and the empirical model is estimated. At optical depth $\tau_{5000} = 0.1$ this difference is small, but near the temperature minimum ($\tau_{5000} = 10^{-4}$) it reaches between 53 and 83 K. The temperature difference between the equator and the poles caused by a hypothetical difference in the heating is estimated. (auth)

25509 FRAUNHOFER LINES WITH LARGE ZEEMAN SPLITTING. Harvey, J. W. (Kitt Peak National Observatory, Tucson, AZ). Solar Phys.; 28: No. 1, 9-13(Jan 1973)

A list of solar spectral lines having simple Zeeman triplet splitting with Landé g-factors equal to or greater than 2.5 is presented. (auth)

25510 ABSORPTION SPECTRUM OF ATMOSPHERIC WATER VAPOR IN THE VICINITY OF THE He 10830 A TRIPLET. Breckinridge, J. B.; Hall, D. N. B. (Kitt Peak National Observatory, Tucson, AZ). Solar Phys.; 28: No. 1, 15-21(Jan 1973).

Wavelengths of clean atmospheric water lines, and some solar lines, in the wavelength interval 10750 to 10900 Å were measured to an accuracy approaching ±1 mÅ. Strengths and wavelengths were measured for all atmospheric water lines with absorption coefficients $>5 \times 10^{-4}$ cm^{-1} gm^{-1} cm^{-2} at ~280K, that lie within 15 Å of the He I 10830 Å feature. The profile of the stronger He component is affected by a weak water line which reduces atmospheric transmission by nearly 1% with 10 mm precipitable water in the line of sight. (auth)

25511 NEW IDENTIFICATIONS OF DISK EMISSION LINES IN THE Ca II H AND K LINE WINGS. Engvold, O.; Halvorsen, H. D. (Univ. of Oslo). Solar Phys.; 28: No. 1, 23-25(Jan 1973).

The disk emission lines in the H and K line wings were recorded at various positions on the solar disk. The line profiles are shown and the wavelengths and suggested identifications of the lines are summarized. (WDM)

25512 He^+ λ4686 LINE IN THE LOW CHROMOSPHERE. Worden, S. P.; Beckers, J. M.; Hirayama, T. (Sacramento Peak Observatory, Sunspot, NM). Solar Phys., 28: No. 1, 27-34(Jan 1973).

An unsuccessful search for the He^+ λ4686 line in the low chromosphere is reported. However, at the location of this line a number of other chromospheric emission lines is detected. This leads to the conclusion that the He^+ λ4686 identification made in the past, as well as other identifications, are probably in error. Additionally the region of the neutral helium λ4713 line is also studied. (auth)

25513 HIGH SPATIAL RESOLUTION PHOTOGRAPHS OF THE SUN IN Lα RADIATION. Prinz, D. K. (Naval Research Lab., Washington, DC). Solar Phys.; 28: No. 1, 35-42(Jan 1973).

Photographs of the Sun in predominantly Lα radiation (centered at 1215.67 Å) with 3″ spatial resolution were taken from an Aerobee rocket shortly after fourth contact by the Moon on the eclipse day of July 10, 1972. This preliminary reporting of the results describes the instrument and shows two of the photographs taken. The supergranulation is manifest and active regions and filaments are well resolved over the entire disk. Densitometer traces across the disk are presented giving the flux incident on the Earth from active regions, cell boundaries, and filaments. (auth)

25514 POLARIZATION OF RED SYSTEM CN LINES IN SUNSPOTS. Harvey, J. W. (Kitt Peak National Observatory, Tucson, AZ). Solar Phys.; 28: No. 1, 43-47(Jan 1973).

The relative intensities of the Zeeman components of molecular spectral lines are not necessarily symmetric in a strong magnetic field. This leads to nonzero net polarization for molecular lines formed in sunspots. The effect is particularly striking for lines of the (0,0) band of the red system of CN. (auth)

25515 RELATIVE UMBRAL INTENSITY OF A LARGE SUNSPOT. Mykland, N. (Univ. of Oslo). Solar Phys.; 28: No. 1, 49-60(Jan 1973).

Simultaneous observations of relative umbral intensities in four wavelength regions are presented. In the visual wavelength region the umbral intensities show lower values than given by most authors. By observing the same spot during different seeing conditions the method of correction for stray light is found to be consistent within the accuracy of the method. In addition, a new simple correction method is suggested. (auth)

25516 OBSERVATIONS OF MOVING MAGNETIC FEATURES NEAR SUNSPOTS. Harvey, K. (Lockheed Solar Observatory, Saugus, CA); Harvey, J. Solar Phys.; 28: No. 1, 61-71(Jan 1973).

The properties of small (<2″) moving magnetic features near certain sunspots were studied with several time series of longitudinal magnetograms and Hα filtergrams. It was found that the moving magnetic features: (1) Are associated only with decaying sunspots surrounded entirely or in part by a zone without a permanent vertical magnetic field. (2) Appear first at or slightly beyond the outer edge of the parent sunspot regardless of the presence or absence of a penumbra. (3) Move approximately radially outward from sunspots at about 1 km s^{-1} until they vanish or reach the network. (4) Appear with both magnetic polarities from sunspots of single polarities but appear with a net flux of the same sign as the parent sunspot. (5) Transport net flux away from the parent sunspots at the same rates as the flux decay of the sunspots. (6) Tend to appear in opposite polarity pairs. (7) Appear to carry a total flux away from sunspots several times larger than the total flux of the sunspots. (8) Produce only a very faint emission in the core of Hα. A model to help understand the observations is proposed. (auth)

25517 RANDOM NATURE OF THE ERUPTION OF MAGNETIC FLUX AT THE SOLAR SURFACE. Howard, R.; Edberg, S. J. (Carnegie Institution of Washington, DC). Solar Phys.; 28: No. 1, 73-75(Jan 1973).

It is concluded that the observations do not contradict the hypothesis that within some latitude, and perhaps longitude limits, eruptions of magnetic flux occur randomly with respect to locations of other active regions, except perhaps for regions in complexes of activity. (WDM)

25518 THERMAL INSTABILITY OF CORONAL NEUTRAL SHEETS AND THE FORMATION OF QUIESCENT PROMINENCES. Raadu, M. A.; Kuperus, M. (Univ., Utrecht). Solar Phys.; 28: No. 1, 77-94(Jan 1973).

It is argued that the quiescent prominences are a natural consequence of the formation and thermal instability of current sheets in the corona. Thus observation and theory of prominences can give vital information on the presence of currents and the topology of magnetic fields in the corona. Conversely by developing the theory of the structure and evolution of current sheets under coronal conditions one can attempt to gain a comprehensive understanding of the structure, evolution, and mass and energy balance of quiescent prominences. A stability analysis for coronal material permeated by a vertical magnetic field rooted in the photosphere, indicates that a condensation will take the form of a thin vertical wedge of ccol matter. The development of a finite condensation is followed and it is shown that photospheric line typing is only important in the initial stages. A perturbation analysis of vertical motions at the neutral sheet shows that thermal instability can lead to overstable oscillations. Cooling of coronal material can lead to both upward and downward mass motions, and gravitational energy release is important to the thermal balance of prominences. Relevant optical and radio observations are discussed. Synoptic observations of the development of active regions and magnetic fields are needed to test the basic hypothesis of the formation or prominences from neutral sheets. (auth)

25519 MAGNETIC PROPERTIES OF SOLAR SURGES. Roy, J. R. (Univ. of Western Ontario, London). Solar Phys.; 28: No. 1, 95-114(Jan 1973).

High resolution on- and off-band Hα filtergrams of disk solar surges obtained with the Vacuum Tower Telescope of the Sacramento Peak Observatory were compared to magnetic data. (1) Surges constitute clusters of very fine dark (sometimes bright) filaments where each thread connects to an Ellerman bomb brightening. If the magnetic map reveals the existence of a satel-

lite polarity as defined by Rust (1968), the bomb(s) lies over it. (2) Although a large fraction of surges is not associated with clearly detectable satellite polarities, events are strongly favored in regions of evolving magnetic features, characterized by dimensions of about 10,000 km and significant flux change over a period of less than a day. A flux change rate of 3×10^{15} Mx s^{-1} has been measured along at least three homologous bomb-surge events in a satellite of region MW 18594. Surges appear to be related to rising flux of one polarity into a region of stronger opposite flux. (3) The trajectories of surges are matched by magnetic lines of force computed in the current-free approximation. (auth)

25520 FLARES ASSOCIATED WITH EFR's (EMERGING FLUX REGIONS). Vorpahl, J. A. (California Inst. of Tech., Pasadena). Solar Phys.; 28: No. 1, 115-122(Jan 1973).

A moderately active sunspot group, McMath 9735, was examined and it was found that 15 of 16 flares observed on October 20–21, 1968 occurred near, and were preceded by, at least one of several EFRs (Emerging Flux Regions) in the area. Flares were larger and more numerous when: (1) the EFR appeared close to already existing spots, (2) a large amount of filament reorientation was occurring, and when (3) the EFR was most active, i.e., it was increasing in area and brightness and was accompanied by violent surging and great brightness fluctuations at the feet of the dark fibrils. Only two flares occurred at an 'inverted' EFR, i.e., a leading spot with f polarity, however the largest event (2B) of the 15 quickly spread to this region after starting in a different EFR. A sunspot appeared in the inverted emerging flux region less than three hours after the flares. However this is thought to be merely an indication of the growing EFR, and, therefore, a secondary effect. (auth)

25521 POLARIZATION INTERFEROMETER FOR 2800 MHz SOLAR NOISE STUDIES WITH 0.5′ FAN BEAM. Bell, M. B.; Covington, A. E.; Kennedy, W. A. G. (National Research Council of Canada, Ottawa). Solar Phys.; 28: No. 1, 123-136(Jan 1973).

The construction and operation of a high-resolution interferometer for solar noise observations at 10.7 cm for the Algonquin Radio Observatory are described. One element is the existing 32 element array of 3 m reflectors while the second is a grating element of 4 reflectors symmetrically placed on the same E–W line. The aperture of 665 m produces a fan beam of 0.5′ E. W. by 2° N. S. Four Faraday rotators in the antenna feeds of the newly commissioned grating enable three Stoke's parameters to be observed. The expected antenna pattern is confirmed by making observations on the brighter radio sources. Observations of the Sun on January 6, 1972 show the range of phenomena to be observed and a detailed study of the association of eight radio emissive regions with all centers of solar activity is presented. (auth)

25522 TIME VARIATIONS IN THE X-RAY EMISSION OF SOLAR ACTIVE REGIONS. Parkinson, J. H. (Univ. of Leicester, Eng.). Solar Phys.; 28: No. 1, 137-150(Jan 1973).

The x-ray emission of individual solar active regions is found from OSO-5 data to vary on three main timescales. Flare associated events typically last for times of minutes to an hour. Events lasting several hours, with several peaks in the x-ray emission, are accompanied by a simplification in the magnetic field, and often mark a turning point in the life of the region. Smooth changes over periods of several days are associated with the general development of a region. Examples of these last two variations are presented. (auth)

25523 THICK TARGET X-RAY BREMSSTRAHLUNG FROM PARTIALLY IONIZED TARGETS IN SOLAR FLARES. Brown, J. C. (Univ. of Glasgow). Solar Phys.; 28: No. 1, 151-158 (Jan 1973).

The effect of partial ionization of a thick target bremsstrahlung source on the emitted x-ray intensity is analyzed. It is shown that a totally ionized target produces an x-ray burst only about one third as intense as that from an unionized target. In the case of a solar flare plasma target, the ionization decreases with increasing depth in the flare. Thus, in an x-ray flare model in which electrons are continuously accelerated down into the chromosphere, high-energy photons are produced with increased efficiency in the deeper layers of the flare plasma with consequent hardening of the x-ray spectrum. As a result, the spectra of nonthermal electrons in flares, inferred from x-ray spectra, are steepened and their total energy correspondingly increased. (auth)

25524 INTENSITY DECREASE OF MICROWAVE BURSTS. Fuerst, E. (Max-Planck-Institut fuer Radioastronomie, Bonn). Solar Phys.; 28: No. 1, 159-168(Jan 1973).

A typical microwave burst on January 11, 1968, 1700 UT was used to demonstrate that the radiation spectrum at maximum phase can be described by gyromagnetic absorption. A model for the source was derived from the observed spectrum. With the aid of this model, an attempt was made to explain the decreasing phase of the burst intensity. Satisfactory agreement with observation was obtained, when one assumed that the cooling of the burst plasma was caused by heat conduction parallel to the magnetic field lines. (auth)

25525 TWO-COMPONENT TEMPERATURE ANALYSIS OF OSO-5 X-RAY FLARE DATA. Herring, J. R. H.; Craig, I. J. D. (University Coll., London). Solar Phys.; 28: No. 1, 169-174(Jan 1973).

Using data covering the 2.6 to 10 Å wavelength range from the OSO-5 satellite a four-parameter model of the emitting region in a flare process is derived. The thermal emission spectrum of Landini and Fossi is used to calculate the plasma parameters, electron temperature, and emission measure. The x-ray flare data is explained by a model which treats the source volume as two time-varying temperature regions. (auth)

25526 SPECTRAL DEVELOPMENT OF A SOLAR X-RAY BURST OBSERVED ON OSO-7. McKenzie, D. L. (Aerospace Corp., El Segundo, CA); Datlowe, D. W.; Peterson, L. E. Solar Phys.; 28: No. 1, 175-182(Jan 1973).

The UCSD solar x-ray instrument on the OSO-7 satellite observes x-ray bursts in the 2 to 300 keV range with 10.24 s time resolution. Spectra obtained from the proportional counter and scintillation counter are analyzed for the event of November 16, 1971, at 0519 UT in terms of thermal (exponential spectrum) and nonthermal (power law) components. The energy content of the approximately 20×10^6K thermal plasma increased with the 60 s duration hard x-ray burst which entirely preceded the 5 keV soft x-ray maximum. If the hard x-rays arise by thick target bremsstrahlung, the nonthermal electrons above 10 keV have sufficient energy to heat the thermally emitting plasma. In the thin target case the collisional energy transfer from nonthermal electrons suffices if the power law electron spectrum is extrapolated below 10 keV, or if the ambient plasma density exceeds 4×10^{10} cm^{-3}. (auth)

25527 SUPERTHERMAL PLASMA NODULES AND THEIR RELATION TO SOLAR FLARES. De Feiter, L. D.; De Jager, C. (Astronomical Inst., Utrecht). Solar Phys.; 28: No. 1, 183-186 (Jan 1973).

Superthermal plasma nodules are defined as bright points (diameter $\lesssim 20''$), visible on high resolution x-ray heliograms. Flares appear to show a strong tendency to occur at the places of these nodules. There are indications that (part of) the hot plasma produced by consecutive flares is accumulated and confined in the superthermal plasma nodules, and that with increasing energy content of a nodule the probability for a drastic change of its magnetic structure increases, thus reducing the possibility for more flares to occur. (auth)

25528 DETAILED CORRELATION OF TYPE III RADIO BURSTS WITH Hα ACTIVITY. I. Active Region of May 22, 1970. Kuiper, T. B. H. (Univ. of Maryland, College Park); Pasachoff, J. M. Solar Phys.; 28: No. 1, 187-196(Jan 1973).

Observations of Type III impulsive radio bursts made at the Clark Lake Radio Observatory were compared with high-spatial-resolution cinematographic observations taken at the Big Bear Solar Observatory. Use of the log-periodic radio interferometer allowed a unique localization of the radio emission. This study concentrated on the particularly active region close to the limb on May 22, 1970. Sixteen of the 17 groups were associated with some Hα activity, 11 of them with the start of such activity. (auth)

25529 OBSERVATIONS ON THE TIME AND FREQUENCY STRUCTURE OF SOLAR DECAMETER RADIO BURSTS. Sastry, C. V. (Indian Inst. of Astrophysics, Kodaikanal). Solar Phys.; 28: No. 1, 197-209(Jan 1973).

Solar radio bursts were observed with a 4-channel radiometer and polarization analyzer at wavelengths around 12 m. The time and frequency resolutions were 10 ms and 100 kHz, respectively. Observations on duration, time profile, and frequency splitting are described. (auth)

25530 ENERGETIC SOLAR PARTICLES AND THEIR RELATION TO OPTICAL FLARES. Biswas, S.; Radhakrishnan, B. (Tata Inst. of Fundamental Research, Bombay). Solar Phys.; 28: No. 1, 211-231(Jan 1973).

It has recently been suggested by several investigators that the accelerated charged particles provide the energy of the optical flare by the ionization loss process. This mechanism was examined assuming different forms of the spectrum of the accelerated protons at lower chromosphere. The flux and the energy spectrum of protons of energy 0.1 to 100 MeV were calculated at successive heights, from 10^3 to 40×10^3 km from the solar surface taking into

account the ionization loss, pitch angle distribution, and density distribution of the neutral and ionized hydrogen in the chromosphere and lower corona. Hence the energy spectrum of the protons escaping from the Sun and the amount of energy dissipated in the solar chromosphere were computed. Comparing the calculated results with the observational data on the solar event of September 28, 1961, it was found that the ionization loss of the accelerated protons and heavier nuclei in the solar atmosphere may supply a significant part of the energy of the optical flare assuming that the fraction, *f*, of magnetic tubes of force extending out of the solar atmosphere is about 1%. The accelerated proton spectrum in the form of power law in kinetic energy seems to be in the most appropriate form. In the event of September 28, 1961 best estimates were made on this basis of the total number and the energy spectrum of protons at injection, the flux and energy spectrum of escaping protons, and the energy dissipated in the solar atmosphere by the accelerated ions. It was found that the possible range of variation of the height of injection level hardly affects the total energy dissipated. The high variability of the intensity of protons released by the Sun is interpreted in terms of the variations of the parameter, *f*, determined by the configurations of the magnetic field lines. (auth)

25531 ESTIMATION OF AN UPPER LIMIT FOR THE SOLAR NEUTRON EMISSION DURING LARGE FLARES. Kirsch, E. (Max Planck-Institut fuer Aeronomie, Lindau, Ger.). Solar Phys.; 28: No. 1, 233-246(Jan 1973).

Solar neutron emission during large flares was investigated by using neutron monitor data from the mountain stations Chacaltaya (Boliva), Mina Aguilar (Argentina), Pic-du-Midi (France), and Jungfraujoch (Switzerland). Registrations from such days on which large flares appeared around the local noon time of the monitor station are superimposed with the time of the optical flare as reference point. No positive evidence for a solar neutron emission was found with this method. However, by using an extrapolation of the neutron transport functions given by Alsmiller and Boughner a rough estimation of mean upper limits for the solar neutron flux is possible. The flux limits are compared with Lingenfelter's model calculations. The flux limits estimated for some special proton flares are consistent with Lingenfelter's predictions for the acceleration phase but are too small for the slowing down phase. Therefore, it is believed that Lingenfelter's assumption of isotropic proton emission fron the flare region is not fulfilled. (auth)

25532 SOLAR WIND AND THE TEMPERATURE–DENSITY STRUCTURE OF THE SOLAR CORONA. Pneuman, G. W. (National Center for Atmospheric Research, Boulder, CO). Solar Phys.; 28: No. 1, 247-262(Jan 1973).

The influence of the solar wind on large-scale temperature and density distributions in the lower corona is studied. This influence is most profoundly felt through its effect upon the geometry of coronal magnetic fields since the presence of expansion divides the corona into magnetically 'open' and 'closed' regions. Each of these regions is governed by entirely different energy transport processes. This results in significant temperature differences since only the open field regions suffer outward conductive heat losses. Because the temperature influences the density in an exponential manner, large density inhomogeneities are to be expected. An approximate method for calculating the temperature and density distribution in a known magnetic field geometry is outlined and numerical estimates are carried out for representative coronal conditions. These estimates show that temperature differences of a factor of about two and density differences of ten can be expected in the lower corona even for uniform base conditions. As a result, the so-called 'coronal holes' are not regarded necessarily as locations of reduced mechanical heating. Alternatively, it is suggested that they are regions of open magnetic field lines being continuously drained of energy content by the solar wind expansion and outward thermal conditions. (auth)

25533 DETERMINATION OF THE TEMPERATURE IN A SOLAR X-RAY FLARE. Rumi, G. C. (Istituto Elettrotecnico Nazionale, Turin). J. Atmos. Terrest. Phys.; 35: No. 4, 639-646(Apr 1973).

The equivalent temperature in a solar x-ray flare for $\lambda \approx 2$Å is deduced from the measurement of the x-ray flux by Explorer 37 and the simultaneous measurement of the ionospheric electron density by vlf and lf records on the Rugby–Turin link. These data yield the value of the effective photoionization cross section in the band $1Å < \lambda < 8Å$. A confrontation of this cross section with the available information concerning the mass absorption coefficient for O and N at different x-ray wavelengths yields the temperature of the flare. For the particular flare considered it turns out to be 1.4×10^7 °K. (auth)

25534 POSSIBLE SOLAR ELECTROGRAPH. Dravins, D. (California Inst. of Tech., Pasadena). Astrophys. Lett.; 13: No. 4, 243-245(Apr 1973).

Some theories of solar flares predict strong electric fields during the pre-flare energy buildup, which might well be observable with existing techniques by measuring the linear polarization in spectral lines that are split due to the Stark effect. (auth)

25535 MICROWAVE PULSATIONS FROM SOLAR FLARES. Maxwell, A.; Fitzwilliam, J. (Harvard Radio Astronomy Station, Fort Davis, TX). Astrophys. Lett.; 13: No. 4, 237-242(Apr 1973).

Fourier analysis of the pulsations that occur in Type IV microwave bursts reveals components with periods in the range 1 to 200 sec, some of which have surprisingly large amplitudes. The characteristics of the pulsating bursts may possibly be accounted for by theories of solar radio pulsations of the type proposed by Chiu. (auth)

25536 MAGNETIC FIELD AND INTERIOR MOVEMENT IN A SPHERICAL FLUID MODEL: CELESTIAL BODY WITH CONVECTION ZONE. II. Schmutzer, E. (Friedrich-Schiller-Univ., Jena, Ger.). 20; 4: No. 4, 301-319(1972). (In German).

A theory, developed in a preceding paper and applied to the case of a spherical shell. As a model the convection zone of the Sun is considered. By a convenient series expansion the nonlinear system of equations of electrodynamics and hydrodynamics is treated. The result of the calculations is a simultaneous theory of the stationary magnetic field and the differential rotation of celestial bodies. The numerical scheme coincides surprisingly well with the empirical facts of the Sun. (auth)

25537 INVESTIGATION OF FIELDS OF SOLAR GRANULATION IN THE PRESENCE OF ATMOSPHERIC DISTURBANCES. Kerimbekov, M. B. Izv. Akad. Nauk Azerb. SSR, Ser. Fiz.-Tekh. Mat. Nauk; No. 2, 82-88(1972). (In Russian).

Various methods of two-dimensional analysis of a field of granules per second were examined, allowing for an increase in the contrast of the granular pattern, and separating it from atmospheric and other disturbances. The prolonging of photospheric structures may be caused by both the presence of a transverse magnetic field and by atmospheric effects. Characteristic dimensions along two axes, derived from two-dimensional analysis, were, respectively, 1.5″ and 1.2″. (KSW)

Galaxies

Refer also to abstracts 25478 and 25496.

25538 MTP INTERNATIONAL REVIEW OF SCIENCE. Volume 3. Spectroscopy. Ramsay, D. A. (ed.). Physical Chemistry, Series One. Baltimore; University Park Press (1972). 344p. $24.50.

A separate abstract was prepared for one of the chapters. (WDM)

For an abstract of an individual chapter see: 25539.

25539 MOLECULES IN SPACE. Snyder, L. E. (Univ. of Virginia, Charlottesville). pp 193-240 of MTP International Review of Science. Vol. 3. Ramsay, D. A. (ed.). Baltimore; University Park Press (1972).

Interstellar molecular spectroscopy has been used to identify twenty-four molecular species in the interstellar clouds of gas and solid particles that pervade the Galaxy. Organic and inorganic species are tabulated. Among these are carbon-13- and oxygen-18-labeled H_2CO and CO, carbon-13-labeled HCN and CH^+, and oxygen-18-labeled OH and H_2O. (JGB)

25540 RECENT EXPERIMENTAL AND THEORETICAL INVESTIGATIONS ON INFRARED AND MICROWAVE MOLECULAR SPECTRA OF ASTRONOMICAL INTEREST. Oka, T. (National Research Council of Canada, Ottawa). Mem. Soc. Roy. Sci. Liege; 3: 37-55(1972).

Recent experimental and theoretical investigations on rotational energy transfer are summarized. In particular emphasis is placed on investigations related to the observed anomalous rotational distributions of interstellar molecules. The reason for the occurrence of anomalous rotational distributions is summarized in two points: (a) slow collisional relaxation and (b) T_K (kinetic temperature) $\neq T_R$ (radiative temperature). A newly developed experimental method for the detailed study of collisional relaxation—the four-level microwave double resonance method—is described. The results of such an experiment are used to explain the non-Boltzmann distribution of interstellar NH_3 observed by Townes and his collaborators. It is also pointed out theoretically

that the $\Delta K = 3$ radiative transitions are weakly allowed in NH_3 due to intramolecular vibration–rotation interaction. The role of such "forbidden" transitions in the rotational relaxation of CH_4 is discussed. Some experimental and theoretical consideration of antimaser action in H_2CO is given. Finally, based on a high-resolution electronic spectrum of H_2O observed by Johns, the selective predissociation of H_2O by vacuum ultraviolet rays is proposed as a possible mechanism for the H_2O maser action. (auth)

25541 CONDENSATION NUCLEI FOR INTERSTELLAR GRAINS AND THE INFRARED EMISSION OF LATE TYPE STARS. de Jong, T. (Observatory, Leiden); Kamijo, F. Mem. Soc. Roy. Sci. Liege; 3: 191-196(1972).

It is shown that condensation nuclei are required to allow the growth of interstellar grains because particles smaller than some critical size are destroyed by interaction with low-energy cosmic rays. In order to keep the computations surveyable the discussion is limited to 2 MeV protons. (BE)

25542 INFRARED AND MICROWAVE EMISSION FROM NEBULAE IN THE GALAXY. Goldberg, L. (Harvard Coll. Observatory, Cambridge, MA). Mem. Soc. Roy. Sci. Liege; 3: 315-324(1972).

Recent developments are reviewed with respect to the observation and interpretation of infrared and microwave spectra of nebulae in the Galaxy. Microwave recombination lines from H(II) regions, H(I) clouds, and planetary nebulae, and infrared spectra from planetary nebulae, H(II) regions, and the galactic center are included. (BE)

25543 CONTINUUM RADIO EMISSION FROM NGC 4656/7 AND NGC 891 AT 408 MHz. Baldwin, J. E.; Pooley, G. G. (Cambridge Univ., Eng.). Mon. Notic. Roy. Astron. Soc.; 161: No. 2, 127-321(1973).

New radio continuum observations of NGC 4656/7 and NGC 891 are described and the results compared with the radio discs of other spiral galaxies. (auth)

25544 PROPERTIES OF THE RADIO CONTINUUM EMISSION FROM INTERACTING GALAXIES. Allen, R. J.; Ekers, R. D.; Burke, B. F.; Miley, G. K. (Univ., Groningen, Netherlands). Nature (London); 241: No. 5387, 260-261(26 Jan 1973).

Several interacting galaxies have been observed recently using the Westerbork Synthesis Radio Telescope at 21 cm wavelength, and a compilation of the data is presented with a view to examining the morphology, strength and frequency of occurrence of their radio emission. In some cases optical photographs show luminous bridges or tails, from which no radio emission was detected. These features have recently been explained by gravitational tides during a close encounter of two galaxies, and the failure to detect radio emission supports this interpretation. It was also concluded that these interacting galaxies do not emit significantly more powerful radio radiation than normal galaxies of similar optical magnitude. It is also concluded that, on the basis of the available data, most of the radio emission from systems of interacting galaxies can be accounted for both in frequency and intensity by the emission expected from the constituent galaxies. This is supported by the observation that the radio morphology of these systems is often similar to that of normal galaxies. NGC 4038/39, NGC 4438/35, and Stephen's Quintet, however, are exceptions in that they show an unusual form of radio emission not centered on a member galaxy nor on optical bridges or tails, and it seems likely that in these cases at least part of the radio emission is a direct result of physical interaction between members of the system. (UK)

25545 NOVAE IN M31 DISCOVERED AND OBSERVED AT ASIAGO FROM 1963 TO 1970. Rosino, L. (Asiago Astrophysical Observatory, Italy). Astron. Astrophys., Suppl. Ser.; 9: No. 3, 347-389(Mar 1973).

The systematic search of novae and peculiar objects in M31 has led to the discovery of other 44 novae from 1963 to 1970. Positrons, magnitudes, identification charts, and light curves are given. Repeated flare-ups at distance of years have been found in two objects. The first (No. 48 = No. 79) is a recurrent nova; the second may be a peculiar object or a foreground U Gem variable of the Galaxy. (auth)

25546 LUNAR OCCULTATIONS OF THE GALACTIC CENTER REGION IN H I, OH, AND H_2CO LINES. I. Observations and Contour Maps. Sandqvist, A. (Univ. of Maryland, College Park). Astron. Astrophys., Suppl. Ser.; 9: No. 3, 391-425(Mar 1973).

In the period from January, 1968 to October, 1970, eleven lunar occultations of the galactic center region have been observed with the 140 foot radio telescope at Green Bank, West Virginia, using a 100 channel autocorrelator for the first two occultations, and a 413 channel autocorrelator for the remaining nine. Eight events have been observed in the 1667 MHz OH line, six in the 1665 MHz OH line, one in the 1720 MHz OH line, six in the 1420 MHz H I line, and two in the 4830 MHz H_2CO line. During five occultations, the 1665 and 1667 MHz OH and the 1420 MHz H I line were observed simultaneously; during one, the 1665 and 1667 MHz OH lines were observed simultaneously with feeds of orthogonal linear polarizations. Continuum occultation curves at the above frequencies have been obtained. The continuum radio source, Sgr A, was occulted eight times, the weaker source, G359.4–0.1, once. Baseline-corrected antenna temperature contour maps on grid of velocity versus sidereal time have been produced for all the observed lines. Opacity contour maps have also been produced, as well as differentiated contour maps of selected parts of the occultations. (auth)

25547 MICROWAVE RECOMBINATION SPECTRA OF MOLECULAR IONS. Joly, F.; McCarroll, R. (Observatoire de Paris, Meudon, France). Mem. Soc. Roy. Sci. Liege; 3: 341-344(1972).

Recombination of molecular ions with low-energy electrons into the excited Rydberg states may occur via the excitation of the vibration–rotation states of the molecular ion core. Thus the molecular ion AB^+ in the vibration–rotation state (v,J) may recombine with an electron by the inverse auto-ionizing reaction. $AB^+(v,J) + e \rightarrow AB\ (v',J';\ nl)$ followed by the subsequent stabilization by the emission of an infra-red photon $AB(v',J') \rightarrow AB(v'',J'') + h\nu(v',J';v'',J'')$. The process, which is of importance only for polar molecules, and is analogous to dielectronic recombination of complex atomic ions, may lead to overpopulation of the highly excited electronic states. Since the energy involved in exciting a vibrational state is of the order of 0.1 eV, this recombination mechanism will be important at temperatures of the order of 1000°K. (auth)

25548 INFRARED LINE RADIATION FROM THE NEIGHBORHOOD OF THE GALACTIC CENTER. Pottasch, S. R. (Univ., Groningen, Netherlands). Mem. Soc. Roy. Sci. Liege; 3: 327-333(1972).

The measurement of the continuous radiation in the radio region indicates that 7 of the 8 sources observed in the galactic center are thermal emitting regions. This is confirmed by the measurement of the radio recombination line in 4 of these regions. In addition there is an extended region of thermal radiation of lower intensity surrounding these regions. Most of the energy from a thermal gas will be emitted in the form of line radiation. The major part of the energy of these lines will be found in the infrared part of the spectrum, even if the temperature of the emitting region is as high as 5000 to 10000°K, simply because transitions to levels which emit visible radiation will be reduced because the energy of even a few electron volts cannot easily be excited by these and lower temperatures. Therefore it is useful to compute in detail the intensities to be expected for these infrared lines. The measurements of these lines will give the abundances of the various ions present and since almost all elements will be represented in various states of ionization, this will make it possible to determine the abundances directly in the region of the galactic centre. (BE)

25549 CALIBRATION PROFILES FOR OBSERVATIONS IN THE 21 cm LINE. Poeppel, W. G. L. (Instituto Argentino de Radioastronomia, Buenos Aires); Vieira, E. R. Astron. Astrophys., Suppl. Ser.; 9: No. 3, 289-295(Mar 1973).

For a set of 5 calibration points on the sky, a large number of hydrogen-line observations were obtained. Since the statistical noise of the resulting average profiles was relatively low, they seemed adequate to be used by other observers working with similar resolutions in angle and frequency. (auth)

25550 GRAVITATIONAL WAVES AND RELATIVISTIC DISKS. Jackson, J. C. (Royal Greenwich Observatory, Eng.). Nature (London); 241: No. 5391, 513-515(23 Feb 1973).

It is stated that relativistic disks enhance the intensity of gravitational radiation in directions near their plane. The gravitational pulses which Weber (Phys. Rev. Lett., 15: 180(1970)) claims to have detected may arise in such a disk situated in the galactic nucleus, with its plane aligned with that of the Galaxy. A typical enhancement factor is 30. (auth)

25551 5-GHz SURVEY OF THE GALACTIC CENTER REGION WITH A RESOLUTION OF 4 ARC MIN. Whiteoak, J. B.; Gardner, F. F. (Max-Planck-Institut fuer Radioastronomie, Bonn). Astrophys. Lett.; 13: No. 4, 205-207(Apr 1973).

A 5-GHz survey with a beamwidth of 4.1 arc min was made of the galactic center region between RA 17h 37m and 17h 52m, and Dec –30° and –27° 30′. H 110α recombination-line observations were obtained at the eight peak positions listed previously by Downes and Maxwell. No line emission was detected at three of the positions, including Sgr A. (auth)

25552 TEMPERATURE OF THE TURBULENT INTERCLOUD MEDIUM. Baker, P. L.; Diadiuk, V. (National Radio Astronomy Observatory, Charlottesville, VA). Astrophys. Lett.; 13: No. 4, 199-203(Apr 1973).

The equation of state has been computed for interstellar hydrogen heated by cosmic rays and subject to density and temperature inhomogeneity due to turbulence. The results of this computation show that the observed intercloud components of galactic hydrogen-line profiles arise from a thermally stable, high-temperature phase of the interstellar medium. (auth)

Cosmology

Refer also to abstract 25975.

25553 GRAVITATIONAL-ELECTROMAGNETIC RESONANCE. Braginskii, V. B. (Moscow State Univ.); Menskii, M. B. Gen. Relativity Gravitation; 3: No. 4, 401-402(Dec 1972).

There exists a specific gravitational–electromagnetic resonance (GER) that can be used for the registration of the shortwave gravitational radiation. An effect of GER arises if a certain electromagnetic process frequency turns out to be in accordance with the gravitational wave frequency. It is shown that a possible device for achieving GER consists of a ring wave-guide with two identical trains of electromagnetic waves propagating in it being at a distance of a quarter of the circle from each other. The device described can be used as a gravitational-wave detector. It is pointed out that the GER arises in a closed wave-guide of any form as well as in a ring one. (UK)

25554 SYMMETRY OF THE UNIVERSE. Schatzman, E. (Univ., Paris). Rev. Fr. Elec.; 45: No. 239, 10–17(1972). (In French).

The combination of three important discoveries (the expansion of the Universe, the positive electron, and cosmological radiation at 3 deg K) may lead to a radical change in man's conception of the Universe: the existence of a Universe containing equal quantities of antimatter and matter. The existence of this symmetry in the Universe has yet to be confirmed. (FR)

25555 EQUIVALENCE OF INERTIAL AND PASSIVE GRAVITATIONAL MASS. Braginskii, V. B.; Panov, V. I. (Moscow State Univ.). Gen. Relativity Gravitation; 3: No. 4, 403–404 Dec 1972).

Torsion balance measurements of the difference in ratios of gravitational to inertial mass for aluminium and platinum are described. The experiment was based on the general principle of that made by P. G. Roll, R. Krotkov and R. H. Dicke (Ann. Phys.; 26: 442(1964)). (UK)

25556 CURVATURE COLLINEATIONS. Aichelburg, P. C. (Univ., Vienna). Gen. Relativity Gravitation; 3: No. 4, 397–400 (Dec 1972).

A classification of plane-fronted pure gravitational waves in terms of "curvature collineations" is given. (auth)

25557 MODELS OF GRAVITATIONAL FIELDS. Petrov, A. Z. (Inst. of Theoretical Physics, Kiev). Gen. Relativity Gravitation; 3: No. 4, 377–390(Dec 1972).

Modelling of the gravitational field is discussed within the framework of Einstein's theory. Modelling is defined as the mapping whereby the geodesic lines (the path of test bodies) go into the family of curves given by the equation of a test body motion in a model. Different possible ways of modelling are singled out—namely, the complete, selective, and approximate-selective ones. The theory is applied to the solar gravitational field. (auth)

25558 MODIFIED EQUATION OF GEODESIC DEVIATION. Hodgkinson, D. E. (Univ. of Liverpool). Gen. Relativity Gravitation; 3: No. 4, 351–375(Dec 1972).

The equation of geodesic deviation is derived under the assumption that the geodesics are neighbouring, but their rate of separation is arbitrary, corresponding, physically, to the relative velocity of two test particles approaching that of light. Some of the consequences of the new equation are discussed. (auth)

25559 POSSIBILITY OF NEGATIVE GRAVITATIONAL ENERGY. Robinson, D. C. (King's Coll., London); Winicour, J. Gen. Relativity Gravitation; 3: No. 4, 325–329(Dec 1972).

The status and physical importance of the question "Can the energy of gravitational fields be negative?" is discussed. To study this question further a particular model of a gravitational shock wave has been developed. The energy corresponding to this model is a scalar functional of the two-geometry of the shock front. Values of the energy for special choices of the shock front have been calculated. These cases all give rise to positive energy, the energy becoming more positive as the shock front becomes more curved. However, no general proof is known to show that the energy is positive for all choices of two-geometries. (auth)

25560 SL(2,C) INVARIANCE OF THE GRAVITATIONAL FIELD. Carmeli, M. (Aerospace Research Labs., Wright Patterson AFB, OH). Gen. Relativity Gravitation; 3: No. 4, 317–323(Dec 1972).

The gravitational field equations of general relativity theory are cast into a Yang–Mills-type theory by use of the group SL (2,C). The spin coefficients take the role of the Yang–Mills-like potentials, whereas the Riemann tensor takes the role of the fields. Comparison of this formalism with that of Utiyama (Phys. Rev.; 101: 1597 (1956)) and Kibble (J. Math. Phys.; 2: 212 (1961)), who related invariance under the Lorentz and the Poincaré groups to the existence of the gravitational field, is discussed. (auth)

25561 TWO EXAMPLES OF NON-RADIATIVE SYSTEMS. Pechlaner, E. (Simon Fraser Univ., Burnaby, B. C.). Gen. Relativity Gravitation; 3: No. 4, 305-315(Dec 1972).

A method of finding approximations for the gravitational field of two nonradiative systems is given. The first system consists of a shrinking body with convex boundary, having certain symmetries. The second system consists of two shrinking bodies which, in the first approximation, approach each other along the x_1-axis with a certain constant relative velocity. The two bodies are assumed to have rotational symmetry around the x_1-axis. (auth)

25562 RELATIVISTIC BEHAVIOUR OF CIRCUMNAVIGATING CLOCKS. Pathria, R. K. (Univ. of Waterloo, Ont.). Nature (London); 241: No. 5387, 263(26 Jan 1973).

Reference is made to the suggestion of Hafele (Amer. J. Phys. 40: 81(1972) and Science 177: 166(1972)), subsequently supported by experiment, that Cs beam clocks borne by commerical jets circumnavigating the Earth may provide supporting evidence for the prediction of Einstein's theory of relativity that if one member of a set of twins departs from the Earth in a spacecraft and later returns to reunite with his sibling, he will be the younger of the two. Strictly speaking this statement is valid only if the frame of reference in which the home-bound sibling remains at rest is an inertial frame, and this is not true of a frame of reference attached to the rotating Earth. This fact was ordinarily disregarded because the relative velocities involved were supposed to be much larger than the velocity difference caused by the foregoing; but in the case of the clocks this is not true and the influence of the Earth's rotation must be taken into account. A mathematical analysis is presented, made directly in the rotating frame of reference, that not only vindicates Hafele's result but also generalises it to more practical situations. The equation derived contains the effect of altitude and that of the directional motion of the clock. The equation may also be applied to a satellite-borne clock. (UK)

25563 ROTATION OF THE EARTH FROM AD 1663–1972 AND THE CONSTANCY OF G. Morrison, L. V. (Royal Greenwich Observatory, Eng.). Nature (London); 241: No. 5391, 519-520 (23 Feb 1973).

It is stated that data for lunar occulations of stars over the period for which the atomic time scale is available are of great interest. They can be used in conjunction with results of earlier analyses to obtain a clearer picture of variations of the rate of rotation of the Earth and to provide evidence relevant as to whether the constant of gravitation is variable. Earlier data and their anomalies are discussed. In this connection Hoyle (Quart. J. Roy. Astron: Soc., 13: 328(1972)) suggested that the anomalies can be resolved if G varies inversely with time, provided that the value of the Moon's deceleration from ancient eclipses is interpreted as including both tidal and nontidal components. The present author is critical of this. (UK)

25564 PHOTON REST MASS AND THE PROPAGATION OF LONGITUDINAL ELECTRIC WAVES IN INTERSTELLAR AND INTERGALACTIC SPACE. Burman, R. (Univ. of Western Australia, Nedlands). J. Phys., A (London); 6: No. 3, 434–444 (Mar 1973).

This paper deals with the effect of a nonzero photon rest mass m on the propagation of longitudinal electric waves in a plasma for which the electrons are treated as a warm fluid with scalar pressure. The Proca equations are used to obtain a dispersion relation which describes two longitudinal wave types; when m = 0, one wave type reduces to the usual electron acoustic wave while the second type, the Proca wave, ceases to exist. For frequencies away from resonance, the cold plasma model is approximately

valid. In this paper, dispersion and absorption are discussed for frequencies both away from and near to resonance; particular attention is paid to Proca waves, and the possibilities of their travelling over interstellar and intergalactic distances are assessed. (auth)

25565 MULTIPLE UNIVERSES. Gold, T. (Cornell Univ., Ithaca, NY). Nature (London); 242: No. 5392, 24-25(2 Mar 1973).

The properties of a closed or nearly closed Universe in which there are substantial variations of mean density on a large scale, so that close "sub-universes" could exist within it, are considered. (auth)

Planetary Phenomena

Refer also to abstract 25979.

25566 EFFECT OF A UNIFORM EXTERNAL PRESSURE ON THE IONOSPHERIC BOUNDARY OF A NONMAGNETIC PLANET IN A STEADY SOLAR WIND. Mukherjee, P. K.; Talwar, S. P. (Univ. of Delhi). Planet. Space Sci.; 21: No. 3, 507-511(Mar 1973).

The interaction of the solar wind with non-magnetic planets has been investigated theoretically taking account of the dilution of a planet's gravity field with distance and a uniform static external pressure of the incident solar wind. This results in the termination of the ionospheric boundary at a finite distance on the nightside of the planet. Numerical results are obtained for the shape of the boundary for different values of the scale height of the ionosphere, and for ratios of static to dynamic pressure of the incident solar wind. (auth)

25567 IONOSPHERIC CURRENTS INDUCED BY SOLAR WIND INTERACTION WITH PLANETARY ATMOSPHERES. Cloutier, P. A.; Daniell, R. E. (Rice Univ., Houston, TX). Planet. Space Sci.; 21: No. 3, 463-474(Mar 1973).

In a steady-state model for the interaction of the solar wind with the atmosphere of a nonmagnetic planet, the magnetized solar wind acts as a dynamo over the dayside of the planet and induces Ohmic currents in the planet's ionosphere. A model for the dynamo mechanism and for the induced current configuration is developed. Based on this model and assumed model atmospheres of Mars and Venus, the distribution of currents entering the ionosphere through the ionopause is calculated. The requirement that the total current be of such a magnitude as to cancel the shock-compressed interplanetary magnetic field fixes the ionopause altitude. The calculations for Venus are in reasonable agreement with observations. The calculations for Mars indicate the possibility of an observable ionopause in the altitude range from 325 to 425 km. (auth)

25568 ULTRAVIOLET ARGON DAYGLOW LINES IN THE ATMOSPHERE OF MERCURY. Zeilik, M.; Dalgarno, A. (Harvard Coll. Observatory, Cambridge, MA). Planet. Space Sci.; 21: No. 3, 383-389(Mar 1973).

The response of an atmosphere of argon to solar uv radiation is investigated. With the assumption that Mercury has an argon atmosphere that is optically thick to ionizing radiation the intensities of the uv dayglow lines resulting from photoelectron impact are calculated. For most of the model atmospheres, the predicted intensities are above the detection threshold of the 1973 Venus–Mercury uv spectrometer of Broadfoot, McElroy, and Belton (Mariner Venus/Mercury 1973 proposal). (auth)

25569 ORIGIN AND CHEMICAL COMPOSITION OF THE EARTH'S CORE. Murthy, V. R.; Hall, H. T. (Univ. of Minnesota, Minneapolis). Phys. Earth Planet. Interiors; 6: No. 1-3 123-130(Dec 1972).

The process of core formation in the Earth is subject to the constraints that it be nearly simultaneous with accretion and yet occur in a manner that the mantle retains radiogenic ^{129}Xe produced from the extinct radioactivity of ^{129}I with a half life of 17.6×10^6 y. From these constraints, it appears that the only feasible mechanism is the segregation of an Fe–FeS melt. Trace element abundances in major classes of meteorites and the silicate fractions of the Earth show that not only is there a high depletion of sulfur in the crust and the mantle, but that it is even more highly depleted than the rare gases, water, and the halogens. From the nature of this depletion pattern and the fact that any model of acceleration of the Earth will necessarily produce an Fe–Fes melt, it is concluded that the light element in the core is largely sulfur with minor amounts of carbon. A consequence of this mode of core formation is found to be the availability of ^{40}K radioactive heat production in the liquid core, estimated at about 10^{19} erg/s at the present time. This energy is more than adequate to produce convective motions in the outer core to generate the geomagnetic field. (auth)

25570 NONTHERMAL RADIO OBSERVATIONS OF THE MAJOR PLANETS. Smith, A. G.; Leacock, R. J.; Carr, T. D.; Lebo, G. R.; Olsson, C. N. (Univ. of Florida, Gainesville). Phys. Earth Planet. Interiors; 6: No. 1-3, 10-16(Dec 1972).

Seventeen years of observations have shown that Jupiter is a complex and intriguing source of emission over the entire radio spectrum accessible from the ground. The observations indicate the presence of intense radiation belts and a strong magnetic field inclined to the axis of rotation. At decametric wavelengths, several remarkably powerful sources are correlated with the rotation of the planet and the orbital motion of the satellite Io. Longer-term variations of these sources may be associated with the sunspot cycle, with Jupiter's orbital motion, or with changes in the internal structure of the planet. There is at most marginal evidence of nonthermal emission from Saturn, and as yet no evidence for such radiation from Uranus or Neptune. (auth)

25571 JUPITER'S DECAMETRIC ROTATION PERIOD AND THE SOURCE-A EMISSION BEAM. Carr, T. D. (Univ. of Florida, Gainesville). Phys. Earth Planet. Interiors; 6: No. 1-3, 21-28 (Dec 1972).

Three new and independent determinations of the 12 y average decametric rotation period are presented. These and earlier measurements made by the same method indicate that the rotation period has not changed by more than 0.1 s in 7.5 y. New evidence supports the hypothesis that the source A beaming effect accounts for the periodicity of approximately 12 y in the general level of decametric activity, as well as the periodicity in the longitude of source A. (auth)

25572 THERMAL RADIO EMISSION FROM JUPITER AND SATURN. Gulkis, S.; Poynter, R. (California Inst. of Tech., Pasadena). Phys. Earth Planet. Interiors; 6: No. 1-3, 36-43 (Dec 1972).

Microwave brightness temperature calculations were carried out for a number of model atmospheres for Jupiter and Saturn. The models considered are characterized by helium to hydrogen number mixing ratios which range from 0 to 0.2. Gaseous ammonia is assumed to be a trace constituent in all the models. The ammonia abundance below the (NH_3) cloud level is a free parameter which is determined by comparing the observed thermal spectrum of Jupiter and the total spectrum of Saturn with the model calculations. The theoretical microwave spectra corresponding to those models in which the ammonia abundance is that expected from an atmosphere containing a solar abundance of elements are found to be in generally good agreement with the observations. This result is shown to be nearly independent of the helium to hydrogen ratio for the models considered. There is no evidence at this time that a nonthermal component contributes to Saturn's microwave spectrum. (auth)

PHYSICS (ATMOSPHERIC)

Auroral and Ionospheric Phenomena

Refer also to abstracts 25507 and 27162.

25573 (N-72-30316) ANALYSIS OF OGO-6 OBSERVATIONS OF THE O I 5577A TROPICAL NIGHTGLOW. Thomas, R. J.; Donahue, T. M. (Pittsburgh Univ., Pa. Space Research Coordination Center). Apr 1972. Contract NAS5-11077. 24p. (NASA-CR-122456; SRCC-168). NTIS.

Atomic oxygen green-line data from the horizon scanning photometer on OGO-6 were examined. Unfolding the satellite data from the tropical F region yields altitude and latitude variations of the O(1S) emissions. The spatial variations of the tropical F-region electron density are then calculated by assuming dissociative recombination and using a model atmosphere. Where comparisons to ground-based data are possible the results are good. Thus, the satellite observations constitute a form of topside sounding of the ionosphere below the F peak and provide synoptic data about this portion of the ionosphere otherwise impractical to obtain. (auth)

25574 DENSITY VARIATION DUE TO PASSAGE OF ELECTROMAGNETIC WAVES IN A SLOWLY VARYING PLASMA. Paul, S. N.; Bondyopadhaya, R. (Jadavpur Univ., Calcutta). Indian J. Pure Appl. Phys.; 10: No. 6, 438-441(Jun 1972).

An expression for the density variation in a slowly varying and magnetoactive plasma due to the propagation of electromagnetic waves is deduced. It is found that the density is directly proportional to the wavelength, the magnetic field strength (the field being perpendicular to the wave propagation), and the number density. The variation becomes very large when $\Omega_0^2 \approx (\omega^2 - \omega_0^2)$ where ω is the frequency of the electromagnetic wave, ω_0 the plasma frequency, and Ω_0 the gyrofrequency. The variation for the E layer of the ionosphere is found to be 18.55×10^{-5} ($\omega = 3.5 \times 10^6$ Hz) during normal conditions. The mean energy flux of the density wave is 60% (for $\omega \approx 3.5 \times 10^6$ Hz; $\lambda = 300$ m) of the electromagnetic wave. This percentage becomes very large when the condition $\Omega_0^2 \approx \omega^2$ is satisfied. (auth)

25575 TOPSIDE IONOSPHERE AT MID-LATITUDES DURING LOCAL SUNRISE. Soicher, H. (Army Electronics Command, Fort Monmouth, NJ). J. Atmos. Terrest. Phys.; 35: No. 4, 657-668(Apr 1973).

Electron-density and scale-height distributions obtained from more than 1000 Alouette-I ionograms have been used to study the structure and variations of the mid latitude topside ionosphere during the sunrise period from 21 May to 4 July 1963. With the assumption that the ionosphere is in a state of diffusive equilibrium, the scale heights are interpreted in terms of combined electron and ion temperature distributions and relative ion concentrations. During the overall sunrise period, there was a strong latitudinal variation of the electron density and scale-height altitude distributions. It was the latitudinal scale-height distribution that determined the effects of solar zenith angle variations at specific latitudes on the temperature and ion-mass distributions. For latitudes south of 55°N geomagnetic latitude, scale-height variations due to solar zenith angle changes are interpreted in terms of temperature increases and mean ion-mass changes. For latitudes north of 55°N, however, these variations are characterized by temperature increases mostly. The electron densities at fixed topside altitudes decreased with increasing illumination at all altitudes and latitudes until about ground sunrise. (auth)

25576 STELLAR OCCULTATION MEASUREMENTS OF MOLECULAR OXYGEN IN THE LOWER THERMOSPHERE. Hays, P. B.; Roble, R. G. (Univ. of Michigan, Ann Arbor). Planet. Space Sci.; 21: No. 3, 339-348(Mar 1973).

Stellar ultraviolet light near 1500 Å is attenuated in the Earth's upper atmosphere due to strong absorption in the Schumann–Runge continuum of molecular oxygen. The intensity of stars in the Schumann–Runge continuum region has been monitored by the University of Wisconsin stellar photometers aboard the OAO-2 satellite during occultation of the star by the Earth's atmosphere. These data have been used to determine the molecular oxygen number density profile at the occultation tangent point. The results of 14 stellar occultations obtained in low and middle latitudes are presented giving the night-time vertical number density profile of molecular oxygen in the 140- to 200-km region. In general, the measured molecular oxygen number density is about a factor of 2 lower than the number densities predicted by the CIRA 1965 model. Also, the number density at a given height appears to decrease with decreasing solar activity. Measurements taken at low latitudes during the August 1970 geomagnetic storm showed a decrease in the molecular oxygen number density at a given height several days after the peak of the storm followed by a slow recovery to pre-storm densities. (auth)

25577 MORPHOLOGY OF AURORAL-ZONE X-RAY EVENTS. 2. Events During the Early Morning Hours. Kremser, G.; Wilhelm, K.; Riedler, W.; Broenstad, K.; Trefall, H.; Ullaland, S. L.; Legrand, J. P.; Kangas, J.; Tanskanen, P. (Max-Planck-Institut fuer Aeronomic, Lindau/Harz, Ger.). J. Atmos. Terrest. Phys.; 35: No. 4, 713-733(Apr 1973).

Auroral-zone electron precipitation during early morning hours (0200 to 0600 h magnetic local time) has been analyzed with the aid of x-ray measurements from northern Scandinavia together with recordings of geomagnetic variations and cosmic noise absorption (CNA). The electron precipitation can be divided in two parts: one occurring close to the location of the electrojet, the other, when the electrojet is far away or absent. The main features of these two types of precipitation distinctly resemble those found earlier in the midnight hours and in the late-morning (SVA-events), respectively. Both types of precipitation may occur simultaneously in the early morning hours. The SVA-type precipitation may extend to very early local times, and the midnight-type precipitation towards dawn. Fast pulsations of the x-ray intensity were found in both types. The midnight-type precipitation apparently stems directly from the acceleration process. The SVA-precipitation was observed to be delayed with respect to the break-up phase in the midnight sector and showed characteristic variations of the energy spectrum in a sense as to support the assumption that drifting electrons were the cause of this phenomenon. It is proposed to call the part characteristic for local times around midnight "direct precipitation" and the SVA-like part "drift precipitation." (auth)

25578 MORPHOLOGY OF AURORAL-ZONE X-RAY EVENTS. 3. Large-Scale Observations in the Midnight-to-Morning Sector. Maral, G.; Broenstad, K.; Trefall, H.; Kremser, G.; Specht, H.; Tanskanen, P.; Kangas, J.; Riedler, W.; Legrand, J. P. (Univ., Toulouse). J. Atmos. Terrest. Phys.; 35: No. 4, 735-751(Apr 1973).

Simultaneous balloon measurements of bremsstrahlung x-rays from electron precipitation over Iceland and Scandinavia indicate that ≈ 30-keV electron precipitation events in the geomagnetic midnight-to-morning sector extend for more than 2000 km in the west–east direction. Some events are spatially directly associated with the auroral electrojet, whereas others occur along the auroral zone, south of the electrojet. Precipitation of the former type seems to start almost simultaneously over the whole region studied, whereas precipitation of the later type starts progressively later as one goes eastwards from the midnight sector. According to previous studies, precipitation along the electrojet is believed to be directly associated with the acceleration of electrons, whereas precipitation south of the electrojet comes from clouds of electrons drifting in the Earth's magnetic field. The large-scale observations presented here tend to confirm this model. (auth)

25579 EFFECTS ON vlf PROPAGATION DURING IONOSPHERE SUBSTORMS. Svennesson, J. (Geophysical Observatory, Kiruna, Sweden). J. Atmos. Terrest. Phys.; 35: No. 4, 761-773(Apr 1973).

The vlf phase level representing ionospherically quiet conditions at auroral latitudes changes considerably with small changes in ionospheric activity, as measured by the K_p index, particularly for signals propagating along the auroral zone in the nighttime ionosphere. Effects on numerous vlf signals propagating across or near the auroral zone during several substorm events of 1969 were studied. A good correlation was found between observed vlf phase anomalies and the extent and intensity of the cosmic noise absorption along the propagation path during the substorms for both daytime and nighttime propagation. Strong vlf phase anomalies were observed on signals propagating at subauroral latitudes outside the midnight sector. It is assumed that local sources of high-energy [illegible]trons (E > 0.2 MeV) were responsible for these anomalies.

25580 [illegible]USION MODEL FOR THE ELECTRON DENSITY DISTRIBUTION ALONG THE EARTH'S MAGNETIC FIELD IN AN F-REGION PLASMA CLOUD. Rao, P. B. (Raytheon Co., Sudbury, MA). J. Atmos. Terrest. Phys.; 35: No. 4, 795-803(Apr 1973).

A diffusive equilibrium model for the electron-density distribu-

tion along the Earth's magnetic field is presented for a plasma cloud generated in the F region of the ionosphere. The underlying analytic formulation is analogous to the one developed earlier by Bannister and Davis for the case of a neutral contaminant released in the upper atmosphere. The shape of the electron-density profile according to this model is characterized by an exponential form in the topside, a Gaussian in the vicinity of the concentration maximum, and a rather rapid cutoff due to diminishing effectiveness of the particle fall and diffusion in the bottom side of the peak. The computed distributions are compared with those derived from the Thomson scatter radar observations collected during a recent series of barium release experiments conducted in Florida. The model and the measured profiles are found to be in good agreement. (auth)

25581 SOLAR LYMAN-α CONTROL OF THE IONOSPHERIC ABSORPTION AT 2775 kHz. Lastovicka, J. (Inst. of Geophysics, Prague). J. Atmos. Terrest. Phys.; 35: No. 4, 815-820(Apr 1973).

The A3 absorption data measured at the Panská Ves Observatory on 2775 kHz are compared with the satellite x-ray and Lyman-α data. The Lyman-α control of absorption and the dominant role of Lyman-α at altitudes around 90 km are observed at the solar zenith angle of 60° under summer 1969 conditions. The absorption is significantly affected by some nonionization factors. (auth)

25582 SPATIAL AND TEMPORAL VARIATIONS OF THE LYMAN-ALPHA AIRGLOW AND RELATED ATOMIC HYDROGEN DISTRIBUTIONS. Meier, R. R.; Mange, P. (Naval Research Lab., Washington, DC). Planet. Space Sci.; 21: No. 3, 309-327 (Mar 1973).

Spatial variations of the atomic hydrogen Lyman-α airglow were observed at 550 km from the OSO-4 spacecraft. Near the subsolar position, the zenith, horizon, and nadir emission rates were 27, 50, and 35 kR, respectively, while near the antisolar position, the respective emission rates were 2.0, 2.7, and 1.2 kR on October 27, 1967. Analyses of these results show that the mean vertical optical depth above satellite altitude is in the range 0.87 to 3.5, with 1.3 as the preferred value. Atomic hydrogen undergoes a diurnal density variation of the order of a factor of 1.7, with a maximum in the early morning and a minimum in the afternoon. A hydrogen altitude profile corresponding to 1100°K exospheric temperature is adequate to explain the data. Temporal variations of the airglow observed from OGO-4 show that the solar line-center Lyman-α flux should typically increase by 50% for an increase in Zurich sunspot count from 30 to 210. (auth)

25583 POSSIBLE CURRENT SYSTEM ASSOCIATED WITH THE S_q^p VARIATION. Kawasaki, K.; Akasofu, S. I. (Univ. of Alaska, College). Planet. Space Sci.; 21: No. 3, 329-337(Mar 1973).

It is suggested that the quiet-day daily magnetic variation in the polar-cap region, S_q^p, results partly from the short-circuit effect of the magnetotail current by the polar ionosphere. This implies that there is an inward field-aligned current from the dawnside magnetopause to the forenoon sector of the auroral oval (positively charged) and an outward field-aligned current to the dusk-side magnetopause from the afternoon sector of the oval (negatively charged), together with the ionospheric (Pedersen and Hall) currents. The distribution of the magnetic-field vectors of both combined current systems agrees with the observed S_q^p vector distribution. The space charges provide an electric-field distribution similar to that which has been observed by polar-orbiting satellites. (auth)

25584 D-REGION RECOMBINATION COEFFICIENTS AND THE SHORT-WAVELENGTH X-RAY FLUX DURING A SOLAR FLARE. Ananthakrishnan, S.; Abdu, M. A.; Piazza, L. R. (Univ. Mackenzie, Sao Paolo, Brazil). Planet. Space Sci.; 21: No. 3, 367-375(Mar 1973).

Vlf phase and amplitude measurements were made on five different frequencies at Sao Paulo, Brazil during a solar flare that occurred on January 22, 1972. The phase and amplitude measurements during the decay phase of the flare were combined with the full-wave solutions of Wait and Spies (NBS Tech. Note, 300 (1964)) to calculate the recombination coefficient in the lower ionosphere. The values thus obtained were lower than those reported by Reid (J. Geophys. Res., 75: 2551(1970)), but were compatible with those reported by Montbriand et al. (Radio Sci., 7: 133(1972)) during solar x-ray events. The effective loss rates were utilized to calculate the ion production at the maximum of the flare, which in turn was utilized to calculate the incident x-ray flux as a function of wavelength at the maximum of the flare. Extensions to the calculations are discussed. (auth)

25585 DAY-SECTOR POLAR F-LAYER DURING A MAGNETOSPHERIC SUBSTORM. Snyder, A. L.; Akasofu, S. I.; Pike, C. P. (Univ. of Alaska, College). Planet. Space Sci.; 21: No. 3, 399-407(Mar 1973).

Ionogram and all-sky camera data have been recorded on the Air Force Cambridge Research Laboratories' Flying Ionospheric Laboratory in the day sector of the auroral oval under conditions of darkness. The airborne measurements show that the polar F-layer irregularity zone, which is characterized on ionograms by a generally nonretarded and spread-F-type echo, exhibits meridional motions similar to the day-sector auroras. The polar F-layer irregularity zone and the day-sector zuroras move equatorward and then move poleward in harmony with the development and decay of a magnetospheric substorm. It is suggested that the polar cusp also moves in essentially the same fashion. (auth)

25586 EMPIRICAL MODEL FOR AVERAGE F-LAYER SCINTILLATION AT vhf/uhf. Fremouw, E. J.; Rino, C. L. (Stanford Research Inst., Menlo Park, CA). Radio Sci.; 8: No. 3, 213-222(Mar 1973).

An empirical approach to modeling the electron-density irregularities in the F layer that are primarily responsible for amplitude scintillation of vhf/uhf signals has been devised and tested. An irregularity model was postulated as a function of geomagnetic latitude, local time of day, season, and sunspot number. The primary parameters of the irregularities that were postulated were their strength and transverse scale-size. The irregularities were assumed to be aligned along the geomagnetic field, and their axial ratio was taken as constant, as were the height and thickness of the irregular layer. The model was tested by computing the fractional rms fluctuation in received power to be expected in a given situation, under the weak-scatter assumption, and comparing the results against values of this or related quantities reported in the literature. The model then was improved by iteration. The development made use of 12 data sets, and final testing employed those 12 plus an independent one. Lack of appropriate data precluded testing poleward of about 70° geomagnetic latitude. The model is offered as a tool for vhf/uhf communication-systems planning, to the extent that the average value of scintillation in a specified circumstance is of engineering value. Geophysical application should be limited to such uses as experiment planning, guiding of intuition, and serving as a basis for more refined modeling. 32 references. (auth)

25587 STATISTICS FOR IONOSPHERICALLY DIFFRACTED vhf/uhf SIGNALS. Rino, C. L.; Fremouw, E. J. (Stanford Research Inst., Menlo Park, CA). Radio Sci.; 8: No. 3, 223-233 (Mar 1973).

A general characterization of the statistics for an ionospherically diffracted, monochromatic plane wave is presented. The main results are restricted to weak scatter, although two possible extensions that accommodate large phase perturbations and multiple scatter are discussed. A detailed discussion of the first-order statistics of amplitude is given. The general Gaussian distribution is discussed together with its Nakagami-distribution approximation and the log-normal distribution. From a segment of ATS-3 satellite data recorded at Lima, Peru, good fits to Gaussian and log-normal distributions at least for the limited dynamic range available are shown. The Nakagami distribution provides only a poor approximation. A transverse scale size of 600 m is inferred, which is believed representative of the nearly linear dependence of the measured field's correlation distance on the Fresnel-zone radius. 25 references. (auth)

25588 FIELD-ALIGNED IONOSPHERIC E-REGION IRREGULARITIES AND SPORADIC E. Basu, S. (Emmanuel Coll., Boston); Vesprini, R. L.; Aarons, J. Radio Sci.; 8: No. 3, 235-246 (Mar 1973).

A continuous series of oblique backscatter observations at 19 MHz made at Plum Island, Massachusetts (56°N invariant), over nearly half a solar cycle is utilized to derive the occurrence characteristics of aspect-sensitive field-aligned irregularities in the E layer and their association with ground-backscattered echoes that are propagated via sporadic E (E_s) reflection. Under quiet magnetic conditions, it is found that the field-aligned echo from E-layer heights, FAE(E), displays a summer evening maximum in conjunction with the E_s echo. A weak secondary maximum is observed in the winter with no detectable field-aligned structures being evident in the daytime E_s. During disturbed magnetic conditions, the E_s ground-backscattered echo is greatly suppressed together with a simultaneous increase of the FAE(E) that also appears in the daytime; no seasonal control is evident. One year's continuous observations at 49 MHz with a narrowbeam antenna showed the quiet time, E_s-associated FAE(E) to be of the discrete type, whereas the FAE(E) obtained during storms were found to be diffuse in nature. These observations are discussed from the point of view of current-plasma instability theories. 35 references. (auth)

25589 PRODUCTION OF SECONDARY ELECTRONS IN NITROGEN BY FAST ELECTRONS AND SIMULTANEOUS EXCITATION OF N_2 BANDS. Borst, Walter L.; Imami, Mahmood (Department of Physics, Southern Illinois University at Carbondale, Carbondale, Illinois 62901). J. Appl. Phys. 44: No. 3, 1133-1141 (Mar 1973).

Band emissions from the second positive (2PG) and first negative (1NG) systems of nitrogen were excited by secondary electrons in the pressure range 10^{-4}–1 Torr. The secondary electrons were produced in ionizing collisions between N_2 molecules and fast primary electrons. Band intensities were monitored inside and outside the interaction volume of the primary electron beam, enabling one to separate the contributions from secondary and primary electrons to the total excitation. 2PG bands were produced solely by secondary electrons whereas 1NG bands were excited by secondary and/or primary electrons depending on the interaction volume viewed. The intensity ratio of the 2PG(0,0) band to the 1NG(0,0) band excited by slow secondary electrons was found to be about 0.5 in the pressure range 10^{-3}–1 Torr at a primary electron energy of 1000 eV. The pronounced difference in the energy dependence of the excitation cross section of the 2PG and 1NG bands was utilized to infer the characteristics of the energy spectrum of secondary electrons ϕ (E). Assuming an analytic form ϕ (E) αE^{-n} for the energy spectrum, a "spectral index" $n \simeq 1.9$ was found using the measured intensity ratio. The energy dependence ϕ (E) $\phi \alpha E^{-1.9}$ applies to secondary electron energies between 11 and approximately 200 eV and was found to be in good agreement with binary encounter theory. The present results were compared with atmospheric measurements of auroral emissions and electron spectra. (auth)

25590 INTERPRETATION OF THE GLOBAL CHARACTERISTICS OF THUNDERSTORM EFFECT ON SPORADIC-E IONIZATION. Datta, R. N. (University Coll. of Science and Tech., Calcutta). Indian J. Pure Appl. Phys.; 10: No. 8, 639-640(Aug 1972).

The phenomenon of thunderstorm effect on sporadic-E ionization is discussed in relation to the present knowledge of sporadic E and its possible formation by the atmospheric gravity waves generated from thunderstorms and thunderqualls. A tentative conclusion is reached suggesting the thunderstorm effect to be a phenomenon related to the temperate-latitude type of E_s layers. The global characteristics of the observational results appear to be in conformity with the expectation. (24 references) (auth)

25591 FIELD ANOMALY OF NEAR WAKES IN A COLLISIONLESS PLASMA. Liu, V. C.; Jew, H. (Univ. of Michigan, Ann Arbor). Phys. Lett.; 43A: No. 2, 159-160(26 Feb 1973).

A variational approach is proposed to determine the induced electric field by charge separation in the near wake of a large negatively charged body moving at mesothermal speeds in a tenuous plasma. The presence of potential well is discussed. (auth)

Magnetospheric Phenomena

Refer also to abstracts 25567 and 26503.

25592 (LA-DC-72-1481) LOW-ENERGY ELECTRON MEASUREMENTS AND SPACECRAFT POTENTIAL: VELA 5 AND VELA 6. Montgomery, M. D.; Bame, S. J.; Hones, E. W. (Max Planck-Institut fuer Extraterrestrische Physik, Munich (West Germany); Los Alamos Scientific Lab., N. Mex). 1972. 33p. (CONF-720970–1). Dep. NTIS.

From Symposium on photon and particle interactions with surfaces and space; Noordwijk, Netherlands (26 Sep 1972).

Low-energy electron measurements from 10 to 1000 eV made by the Los Alamos plasma probes aboard the VELA Satellites provide a direct measure of the spacecraft potential with respect to the surrounding plasma when this potential rises above the lowest measured energy level, and in addition, give an indirect indication when the potential is smaller. It has been found, as expected, that the spacecraft potential is a strong function of the incident electron flux from the ambient plasma and, therefore, depends strongly on the region in which the measurements are made (solar wind, magnetotail, etc.). In addition, information concerning the dependence of spacecraft potential on photocurrent was obtained from data gathered in the magnetotail and solar wind during eclipses of the Sun at the spacecraft. In the high-latitude magnetotail, when the electron flux from the ambient plasma is low, the potential is positive and can rise to over 70 volts. The measured relationship between the incident electron flux f_e and the satellite floating potential φ can be approximated (for f_e between 1×10^7 and 8×10^7 cm^{-2} sec^{-1}) by the relation $f_e = (f_s/4) \exp(-\varphi/\varphi_0)$; where f_s (the photoelectron saturation flux) = 7.3×10^8 cm^{-2} sec^{-1}, and φ_0 = 13.6 V. The spacecraft potential in the solar wind in sunlight (where $f_e \approx 3 \times 10^8$ cm^{-2} sec^{-1}) is positive and is usually between +3 and +6 V. In the solar wind, but in darkness, the s/c potential is slightly negative — most probably between 0 and −2 V. (auth)

25593 (N-72-29280) Vhf/uhf TECHNIQUE FOR THE DETERMINATION OF THE COLUMNAR ELECTRON CONTENTS OF THE PLASMASPHERE AND OF THE PROTONOSPHERE USING GEOSTATIONARY SATELLITE TRANSMISSION: OBSERVATIONS DURING MAGNETIC STORMS. Almeida, O. G. (Stanford Univ., Calif. Radioscience Lab.). May 1972. 101p. (NASA-CR-127804; SU-SEL-72-19). NTIS.

Measurements of the total electron content of the plasmasphere up to geostationary heights were made using the beacon transmitters aboard the satellite ATS-3. The technique employed is a combination of the phase–path length difference and the Faraday-rotation-angle methods. Such a combination permits very accurate determination of the integration constant necessary to convert phase–path length difference data into information about the absolute value of the columnar content. (auth)

25594 (N-72-29720) MODULATIONAL INSTABILITY OF WHISTLERS IN COLD PLASMAS. Brinca, A. L. (Stanford Univ., Calif. Inst. for Plasma Research). Mar 1972. 20p. (NASA-CR-127802; SU-IPR-464). NTIS.

The paper obtains the modulational stability spectrum of whistlers in cold plasmas taking into considertion both ion motion and relativistic effects. The unstable band is contiguous to $\omega_{e/4}$ and, depending on the plasma density, lies above or below that frequency. ω_e is the electron cyclotron frequency of the static magnetic field. The relevance of the instability to whistlers in the magnetosphere is discussed. (auth)

25595 NONLINEAR HYDRODYNAMIC VLF WAVE SCATTERING IN THE EARTH'S MAGNETOSPHERE. Trakhtengerts, V. Yu. (Gorky State Univ., USSR). Planet. Space Sci.; 21: No. 3, 359-366 (Mar 1973).

The paper deals with a nonlinear instability of quasi-monochromatic vlf signals and whistlers in the Earth's magnetosphere due to induced scattering. The instability growth rates and the threshold values of the signal amplitude at which the instability occurs have been found. The instability is shown to be more effectively excited when the initial transverse vlf wave transforms into plasma oscillations at the lower-hybrid resonance (LHR) frequency and may be responsible for the phenomena such as trigger LHR emission, the amplitude and phase modulation of artificial vlf signals, and be the origin of some types of discrete vlf signals. (auth)

25596 ROTATIONAL DISCONTINUITIES IN AN ANISOTROPIC PLASMA. 2. Hudson, P. D. (Queen's Univ., Belfast). Planet. Space Sci.; 21: No. 3, 475–483(Mar 1973).

The theoretical work on rotational discontinuities in an anisotropic plasma is extended and the results are presented in a form more convenient for comparison with observations in the solar wind. Diagrams are presented to help observers identify rotational discontinuities using the values of ρ, B, and β on either side. Under average solar-wind conditions at 1 AU it is found that B and ρ change by at most a factor of ~1.7, and in a $\beta \lesssim 0.4$ plasma ρ changes by at most a factor of 1.1 and B is virtually constant. The changes in physical parameters across a typically rotational discontinuity are illustrated, and the special cases of downstream isotropy and of $\rho \perp / B$ = constant are considered in detail. (auth)

25597 PRECISE CALCULATION OF THE MAGNETOSPHERE SURFACE FOR A TILTED DIPOLE. Choe, J. Y.; Beard, D. B.; Sullivan, E. C. (Univ. of Kansas, Lawrence). Planet. Space Sci.; 21: No. 3, 485–498(Mar 1973).

The shape of the magnetosphere has been calculated self-consistently for inclinations of the Earth's magnetic dipole from perpendicular to the solar wind. Inclination angles of 0 to 35° have been chosen in steps of 5° and various smooth trends in the surface characteristics with increasing inclination angle noted. The surface points and the complete field at the surface points have been calculated for the entire surfaces. The neutral point region has been given precise study in one degree steps and is found to be tangent to the solar-wind velocity and to have a smooth continuous curvature. (auth)

25598 EFFECT OF THE EARTH'S BOW SHOCK AND MAGNETOSHEATH ON THE INTERACTION OF A DISCONTINUITY IN THE SOLAR WIND WITH THE MAGNETOSPHERE. Rigby, B. J.; Mainstone, J. S. (Univ. of Queensland, St. Lucia, Australia). Planet. Space Sci.; 21: No. 3, 499-506(Mar 1973).

A theoretical model is proposed for the interaction of a plane discontinuity in the solar wind with the magnetosphere. The pres-

ence of the bow stock and magnetosheath is taken into account, the calculation being based on the Spreiter et al. (Planet Space Sci., 14: 223(1966)) gas-dynamic model for a solar-wind Mach number M = 5. The model proposed predicts the manner in which the shape of the interplanetary discontinuity is distorted in its passage through the magnetosheath; it is found that the point of first impact with the magnetopause makes an angle of 56° with the Sun–Earth line for relatively quiet solar-wind conditions. (auth)

25599 FREQUENCY AND PERIOD RELATIONSHIPS FOR $\pi 2$ MICROPULSATIONS. Doobov, A. L. (Univ. of Queensland, St. Lucia, Australia). Planet. Space Sci.; 21: No. 3, 532-534(Mar 1973).

Using measurements made at 3 sites, correlation coefficients are calculated between both the period and the frequency of a $\pi 2$, on the one hand, and the planetary magnetic-activity index and the magnitude of the accompanying auroral bay, on the other. The coefficients are consistently larger for frequency than for period. (auth)

25600 ANALYTICAL STUDY OF THE CHANGES IN THE DIRECTION OF THE PERPENDICULAR TO THE WAVE DURING THE MAGNETOSPHERIC TRAJECTORY OF Pc1 PULSES. Lacoume, J. L. (Univ., Grenoble, France). Compt. Rend., Ser. A, B; 275: No. 21, 809-812(20 Nov 1972). (In French).

A new method for studying the variation in the direction perpendicular to the Pc1 wave is presented. It is shown that in a slowly varying magnetosphere, the direction perpendicular to the wave tends to become perpendicular to the Earth's magnetic field but many up and down trajectories take place before the perpendicular resonance is reached. (FR)

25601 ACTIVITIES IN SPACE RESEARCH AT THE MAX-PLANCK INSTITUT FUER EXTRATERRESTRISCHE PHYSIK, GARCHING BEI MUENCHEN (G.F.R.). Measurement of Energetic Particles in the Magnetosphere and in Interplanetary Space. Hovestadt, D. (Max-Planck-Institut Fuer Physik Und Astrophysik, Garching, Ger.). Ind. At. Spatiales; 16: No. 6, 55-57 (Dec 1972).

Experiments performed on board the Azur and ESRO-IV satellites are briefly presented. They are concerned with measurements of energetic protons and alpha particles in the magnetosphere. (FR)

PHYSICS (ATOMIC AND MOLECULAR)

Beams and Their Reactions

Refer also to abstracts 26630 and 26631.

25602 ELECTRON RADIATION AND SURFACE ROUGHNESS OF METALS. Harutyunyan, F. R.; Hovhannissian, R. A.; Mkhitarian, A. Kh.; Rostomian, B. O. (Inst. for Physical Research, Erevan). Phys. Lett., A; 43A: No. 2, 107-108(26 Feb 1973).

The experimental investigation of radiation from Al and Ge polished and rough targets, irradiated by electrons, was made. It is concluded that the observed redundant radiation, arising at electron flight grazing angles, is conditioned by target surface roughness. (auth)

25603 ANISOTROPY OF COMPTON PROFILE ON VANADIUM SINGLE CRYSTAL. Terasaki, O. (Tokyo Univ.); Fukamachi, T.; Hosoya, S.; Watanabe, D. Phys. Lett., A; 43A: No. 2, 123-124 (26 Feb 1973).

The Compton profiles were measured on a spherical single crystal of vanadium along three major axes using a 100 mCi ^{241}Am source and a Ge(Li) detector. The anisotropy was clearly detected and compared with two available calculations. (auth)

25604 YIELDS AND TRAPPING OF NEUTRAL DEUTERIUM BEAMS CONTAINING $^3\Pi_u$ MOLECULES. Berkner, K. H.; Morgan, T. J.; Pyle, R. V.; Stearns, J. W. (Univ. of California, Berkeley). Nucl. Fusion; 13: No. 1, 27-34(Jan 1973).

Experimental yields of neutral ground-state atoms and molecules and long-lived $^3\Pi_u$ excited molecules from interactions of 30- to 120-keV D_2^+ ions in magnesium vapor are reported. Results of calculations that approximate trapping in magnetically confined plasmas of beams produced by either D^+ or D_2^+ ions neutralized in Mg-vapor are given. (auth)

Atomic and Molecular Properties

Refer also to abstracts 24327, 25720, 26000, 26244, 26255, and 26318.

25605 (CONF-720404-(Vol.1)) PROCEEDINGS OF THE INTERNATIONAL CONFERENCE ON INNER SHELL IONIZATION PHENOMENA AND FUTURE APPLICATIONS, APRIL 17-22, 1972. Fink, R. W.; Manson, S. T.; Palms, J. M.; Rao, P. V. (eds.) (Georgia Inst. of Tech., Atlanta; Emory Univ., Atlanta, GA). Jan 1973. 822p. Dep. NTIS.

From International Conference on Inner Shell Ionization Phenomena and Future Applications; Atlanta, Georgia, United States of America (USA) (17 Apr 1972).

The conference included 47 papers, 3 of which were abstracted previously in NSA. For abstracts of these papers see CONF-720404(Vol 1) in a cumulative report number index. Separate abstracts were prepared for 38 papers. Other papers were outside the scope of NSA. (JFP)

For abstracts of individual papers see: 24692, 25606-25622, 25641, 25642, 25711-25715, 26140-26143, 26170, 26180, 26234, 26288, 26289, 26317, 26318, 26441, and 26489.

25606 (CONF-720404-(Vol.1), pp 43-58) THEORETICAL L_2 SUBSHELL FLUORESCENCE YIELDS AND COSTER-KRONIG TRANSITION PROBABILITIES F_{23} BASED ON THE GREEN-SELLIN-ZACHOR INDEPENDENT-PARTICLE MODEL. Chen, M. H.; Crasemann, B. (Univ. of Oregon, Eugene). Jan 1973.

From International conference on inner shell ionization phenomena and future applications; Atlanta, Georgia, USA (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

Auger and Coster-Kronig transition probabilities to the atomic L_2-subshell have been calculated in j-j coupling for 18 elements with atomic numbers $26 \leq Z \leq 94$. Numerical bound-state and continuum wave functions were computed for the analytic electron-atom independent-particle model potential of Green et al. The theoretical Auger widths and Coster-Kronig widths were combined with Scofield's x-ray emission rates to derive fluorescence yields ω_2 and Coster-Kronig transition probabilities f_{23}. Results for ω_2 are in good agreement with experiment. The previously noted discrepancy between theoretical and experimental values of f_{23} is reduced. A very sharp discontinuity in f_{23} at $Z = 30$ is found. (auth)

25607 (CONF-720404-(Vol.1), pp 59-79) AUGER SPECTRA AND FLUORESCENCE YIELDS FOR THE 3p AND THE 3d SHELL. Bhalla, C. P. (Kansas State Univ., Manhattan). Jan 1973.

From International conference on inner shell ionization phenomena and future applications; Atlanta, Georgia, USA (17 Apr 1972).

In Proceedings of the international conference on inner shell phenomena and future applications.

The Auger group rates and fluorescence yields are presented for Z = 35, 40, 45, 50, 55, 60, 65, 70, 75, 80, 83 and 85 for a vacancy in either the 3p shell or the 3d shell. The present calculations have been performed with the nonrelativistic Hartree-Fock-Slater Model with the exchange approximation of Herman, Van Dyke and Ortenburger. The theoretical fluorescence yields can be used in converting the experimental M-shell x-ray production cross sections by protons and alpha particles to the cross section for M-shell vacancy production. (auth)

25608 (CONF-720404-(Vol.1), pp 116-127) K-SHELL FLUORESCENCE YIELDS OF LOW Z ELEMENTS DETERMINED FROM GASEOUS SAMPLES. Moljk, A. (Univ., Ljubljana, Yugoslavia). Jan 1973.

From International conference on inner shell ionization phenomena and future applications; Atlanta, Georgia, USA (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

K-shell fluorescence yields of low Z elements can be determined by use of gaseous samples added to the filling gas of the proportional counter which discriminates between electrons and fluorescent radiation. The sample is excited by a beam of characteristic K-radiation from an appropriate target and the spectrum obtained in a wall-less multiwire proportional counter studied. For the K-shell fluorescence yield, the number of counts in the photopeak and the escape peak have to be corrected for electron escape and x-ray absorption, and the probability determined for the photoeffect in the K-shell and in higher shells. Experimental details are mentioned and results given. The higher values obtained are in agreement with recent computed values. The method is a better alternative to the use of solid sources in the low Z region. Some possibilities for further improvements are indicated. (auth)

25609 (CONF-720404-(Vol.1), pp 175-196) L AND M SHELL AND SUBSHELL FLUORESCENCE AND COSTER-KRONIG YIELDS. McGeorge, J. C. (Georgia Inst. of Tech., Atlanta). Jan 1973.

From International conference on inner shell ionization phenomena and future applications; Atlanta, Georgia, USA (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

A brief review of experimental measurements of L and M shell fluorescence yields is given. Recent results and some work currently in progress at Georgia Tech on the L_2 and L_3 subshells in the middle-to-high Z region will be discussed in more detail. Comparison with theoretical estimates shows reasonable agreement for the L_2 and L_3 fluorescence yields but discrepancies of up to 30% for the L_2 Coster-Kronig yields. Very little empirical data are available concerning the fluorescence and Coster-Kronig yields of the L_1 subshell and of the M shell. Some of the difficulties associated with the measurement of these quantities will be presented together with suggestions for future work. (auth)

25610 (CONF-720404-(Vol.1), pp 233-243) L_{II} SUBSHELL ATOMIC YIELDS OF ELEMENTS WITH $Z \approx 90$. Ferreira, J. G. (Univ., Lisbon). Jan 1973.

From International conference on inner shell ionization phenomena and future applications; Atlanta, Georgia, USA (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

A summary of the experimental values of fluorescence (ω_2), Auger (a_2), and Coster-Kronig (f_{23}) L_{II} subshell yields in elements with $Z \approx 90$ is presented; some recent results for Z = 88 and 92 are included. Comparison is made with theoretical values predicted in this region of atomic numbers. (auth)

25611 (CONF-720404-(Vol.1), pp 257-266) ANGULAR CORRELATION BETWEEN K AND L X RAYS IN URANIUM: THE $K\alpha_1$-$L\alpha_{1,2}$ CASCADE. Catz, A. L. (Univ. of Massachusetts, Boston); Finkel, L. Jan 1973.

From International conference on inner shell ionization phenomena and future applications; Atlanta, Georgia, USA (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

Angular correlations between K and L x rays in uranium were measured. The uranium x rays were obtained from a radioactive source of ^{233}Pa. High resolution Ge(Li) and Si(Li) low energy photon spectrometers were used for the detection of the K and L x rays respectively. The angular correlation function for the $K\alpha_1 - L\alpha_{1,2}$ cascade was found to be $W(\theta) = 1 + (4.12 \pm 0.57) \times 10^{-2} P_2(\cos\theta)$. The result is in excellent agreement with theory, when the M2 admixtures in the x-ray transitions are taken into account. (auth)

25612 (CONF-720404-(Vol.1), pp 267-277) ANGULAR CORRELATIONS OF X RAYS: K-L X-RAY CASCADES IN $^{239}Pu^+$. Macias, E. S.; Zalutsky, M. R. (Washington Univ., St. Louis). Jan 1973.

From International conference on inner shell ionization phenomena and future applications; Atlanta, Georgia, USA (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

Angular correlations between K and L x rays in ^{239}Pu were measured. The Pu x rays were obtained from a radioactive source of ^{243}Cm in the chemical form $Cm(NO_3)_3$. The K x rays were detected with a cooled Ge(Li) spectrometer with energy resolution of 470 eV (FWHM) for the 104 keV $K\alpha_1$ x ray of Pu. The L x rays were detected with a cooled Si(Li) spectrometer with energy resolution of 230 eV (FWHM) for 14-keV photons (the energy of $L\alpha_{1+2}$ x rays of Pu). The angular correlation coefficients for the $K\alpha_1 - Ll$, $K\alpha_1 - L\alpha_{1+2}$, $K\alpha_1 - L\beta'$, $K\alpha_1 - L\beta''$, and $K\alpha_1 - Ll$ are $A_{22} = (25 \pm 2) \times 10^{-2}$, $A_{22} = (4.5 \pm 0.4) \times 10^{-2}$, $A_{22} = (1.7 \pm 0.8) \times 10^{-2}$, $A_{22} = (2.6 \pm 0.8) \times 10^{-2}$, and $A_{22} = (1 \pm 2) \times 10^{-2}$ respectively. The results for the $K\alpha_1 - L\alpha_{1+2}$ cascade are in good agreement with theoretical predictions but the result for the $K\alpha_1 - Ll$ cascade deviates significantly from theory. (auth)

25613 (CONF-720404-(Vol.1), pp 338-345) RELATIVE X-RAY TRANSITION PROBABILITIES TO THE K-SHELL FOR $81 < Z < 96$. Schmidt-Ott, W. D.; Tolea, F.; Fink, R. W. (Georgia Inst. of Tech., Atlanta). Jan 1973.

From International conference on inner shell ionization phenomena and future applications; Atlanta, Georgia, USA (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

In addition to recent intensity measurements of the major K x-ray groups for Z = 81, 92, 94, and 96, the relative x-ray transition probabilities for Z = 86, and 88 have been measured in the decays of ^{223}Ra and ^{227}Th, respectively. The sources were prepared by chemical separation from ^{227}Ac in radioactive equilibrium with its daughter products (solvent extraction with tributyl phosphate). For the detection of K x rays two high resolution Ge(Li) x-ray detectors and a high purity Ge x-ray detector of the intrinsic type were used. The efficiencies of these detectors were measured using IAEA standards and the K x ray-K conversion electron coincidence method. The results are as follows: for Z = 86, $K_{\alpha_2}/K_{\alpha_1} = 0.598 \pm 0.006$, $K'_{\beta_2}/K_{\alpha_1} = 0.348 \pm 0.006$, $K'_{\beta_2}/K_{\alpha_1} = 0.108 \pm 0.004$, $K_\beta/K_\alpha = 0.286 \pm 0.005$; for Z = 88, $K_{\alpha_2}/K_{\alpha_1} = 0.604 \pm 0.008$, $K'_{\beta_1}/K_{\alpha_1} = 0.355 \pm 0.010$, $K'_{\beta_2}/K_{\alpha_1} = 0.113 \pm 0.005$, and $K_\beta/K_\alpha = 0.290 \pm 0.006$. The error limits are 2σ statistical uncertainties to which a systematic error in the detector efficiencies has been added linearly. A disturbing gamma following the α decay of ^{227}Th is hidden under the K'_{β_1} peak for Z = 88. The intensity of this K'_{β_1} group has been corrected by $(7.8 \pm 2.0)\%$. The results are presented together with the recent results for Z = 81, 92, 94, and 96, and are compared with theory. The experimental $K_{\alpha_2}/K_{\alpha_1}$ ratios for Z between 81 and 96 are slightly lower than theory. This trend becomes more obvious with increasing Z. The experimental $K'_{\beta_1}/K_{\alpha_1}$, $K'_{\beta_2}/K_{\alpha_1}$, and K_β/K_{α_1} ratios for Z > 81 consistently exceed the theoretical values. For the K_β/K_α ratios, at Z = 81 a deviation of 4%, and at Z = 96, of 7% is found. (auth)

25614 (CONF-720404-(Vol.1), pp 346-369) CHEMICAL AND ISOTOPE SHIFTS AND HYPERFINE BROADENING X-RAY LINES. Sumbaev, O. I. (Leningrad Inst. of Nuclear Physics). Jan 1973.

From International conference on inner shell ionization phenomena and future applications; Atlanta, Georgia, USA (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

The theory of the small energy changes of K- and L-shell x-ray lines of heavy elements due to the chemical shift and isotope shift as well as the line broadening caused by the hyperfine interaction is reviewed. Recent experimental work is also reviewed and compared with the theoretical predictions. The possibilities opened up by the use of semiconductor detectors in this work are discussed. (auth)

25615 (CONF-720404-(Vol.1), pp 370-395) ISOTOPE SHIFTS IN X-RAY LINES. Boehm, F. (CERN, Geneva). Jan 1973.

From International conference on inner shell ionization phenomena and future applications; Atlanta, Georgia, USA (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

Experiments on isotopic energy shifts of K x-rays are analyzed in terms of parameters of the nuclear charge distribution. Extranuclear effects, such as chemical shifts, are discussed. (auth)

25616 (CONF-720404-(Vol.1), pp 437-454) RECENT TRENDS IN AUGER ELECTRON SPECTROSCOPY. Mehlhorn, W. (Univ. of Freiburg, Ger.). Jan 1973.

From International conference on inner shell ionization phenomena and future applications; Atlanta, Georgia, USA (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

Most effort in earlier research work has been made to determine the energies, intensities and in some cases also line widths of normal Auger transitions. Although full agreement between theoretical and experimental line intensities of normal Auger spectra has not yet been reached, not even in the simplest case of KLL spectra, this problem will not be treated. The recent development of Auger electron spectroscopy (AES) to study correlation effects in atoms and molecules through multiparticle transitions during the excitation and de-excitation processes of inner shell vacancies will be discussed briefly. Two recent trends of AES will be treated more extensively. The application of AES to molecules and the angular distribution of Auger electrons following the impact ionization by a directed electron beam is discussed. Assuming the ionization process followed by the Auger transition to be a two stage process, the theoretical angular distribution of any Auger transition for atoms with closed shells in the neutral ground state prior to ionization and with nuclear spin I = 0 will be given. It will be shown that first experimental results on the nonisotropic angular distribution are in full accord with theory. (auth)

25617 (CONF-720404-(Vol.1), pp 455-474) POSITIONS OF THE K-LL AUGER LINES. Asaad, W. N. (Cairo Univ., Egypt). Jan 1973.

From International conference on inner shell ionization phenomena and future applications; Atlanta, Georgia, USA (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

A review of the theory and semi-empirical formulas used to calculate the positions of the K-LL Auger lines is given. A correction of the form $-4 \times 10^{-6} (Z-3)(Z-12)^2(Z-52)^2$ eV in the Slater's integrals F^0's is found to bring closer agreement between experiment and the theoretical calculations of Asaad (1970) for $10 \leq Z \leq 55$. (auth)

25618 (CONF-720404-(Vol.1), pp 490-508) EFFECT OF ATOMIC CORRELATIONS ON KLL AUGER TRANSITIONS. Chattarji, D.; Talukdar, B. (Visva-Bharati Univ., Santiniketan, West Bengal, India). Jan 1973.

From International conference on inner shell ionization phenomena and future applications; Atlanta, Georgia, USA (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

Relative intensities of the Auger lines for low Z values show considerable discrepancies between theory and experiment. This seems to point to the necessity of a more detailed investigation into the nature of the wavefunction in the lighter atoms. Starting from the fact that the Auger process arises basically from the interaction between the two participating electrons, we assume that this interaction gives rise to a correction in the total Hamiltonian of the system which takes the form of a correlation energy. Coming to wavefunctions, the effect of this correlation should be such that bound state electrons in the same spatial orbital having opposite spins avoid each other more strongly than would be expected in the usual Hartree-Fock-Slater formulation. This is insured by introducing in the wavefunction a correlation factor which is a function of the inter-electron distance $r_{12} = |\vec{r}_1 - \vec{r}_2|$. Our preliminary ansatz is of the form $\Psi_c = \Psi_a(nln'l';S\ L\ J\ M)(1 - \lambda e^{-\mu r_{12}})$, where λ and μ are variational parameters and Ψ_a the usual uncorrelated antisymmetrized

two-electron hydrogenic wavefunction. We have used an extreme LS coupling without configuration interaction. For the final state we do not assume any correlation. Considerable enhancement of the KLL relative intensities is obtained, the comparison with experiment being quite encouraging for Z = 17 for which detailed experimental observations exist. (auth)

25619 (CONF-720404-(Vol.1), pp 523-547) K-SHELL AUGER ELECTRON SPECTRA: A REVIEW. Geiger, J. S. (Atomic Energy of Canada, Ltd., Chalk River, Ontario). Jan 1973.

From International conference on inner shell ionization phenomena and future applications; Atlanta, Georgia, USA (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

A survey is made of the K-LL Auger spectra of the ~40 elements that have been studied experimentally. These data confirm that the intermediate coupling description introduced by Asaad and Burhop is appropriate for most elements in the periodic table. For low Z cases approximate agreement is obtained between non-relativistic transition rates and experiment when configuration mixing is included. The relativistic predictions of Bhalla and Ramsdale account for all of the principal line intensities but the $K\text{-}L_{II}L_{II}$ in the high Z region. Relativistic transition rates are now needed in a form which permits their use within the intermediate coupling formulism known to apply in high Z elements. Intensity data exist on the K-LM spectrum of eleven elements. These results (Z > 47) favor the relativistic predictions of Bhalla over the non-relativistic predictions of Rao et al. Additional studies of KLM spectra are needed to assess critically the available predictions. (auth)

25620 (CONF-720404-(Vol.1), pp 559-661) PHENOMENOLOGICAL SYSTEMATICS OF L- AND M-AUGER SPECTRA. Haynes, S. K. (Michigan State Univ., East Lansing). Jan 1973.

From International conference on inner shell ionization phenomena and future applications; Atlanta, Georgia, USA (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

All the literature through October 1971 in Physics Abstracts has been reviewed. There are at least 107 articles on L-Auger spectra including elements 12 to 42, 49, 52, 55, 56, 63, 66, 70, 71, 72, 75, 77 to 84, 91 to 93. Some of these spectra have not been analyzed. On M-Auger spectra there are at least 49 articles including elements 21 to 42, 44 to 60, 62 to 84. A bibliography for L and M spectra arranged by year of publication and containing information on spectra studied, method of production, type of spectrometer, and type of data presentation is included together with an appendix on L-Auger spectra arranged by atomic number in which all the data on each element are briefly presented and discussed. Included are energy and intensity systematics, intermediate coupling, and M-Auger spectra. (JFP)

25621 (CONF-720404-(Vol.1), pp 720-729) BINDING ENERGIES FROM EXCITATION CURVES. Burr, A. F. (New Mexico State Univ., Las Cruces). Jan 1973.

From International conference on inner shell ionization phenomena and future applications; Atlanta, Georgia, USA (17 Apr 1972).

Proceedings of the international conference on inner shell ionization phenomena and future applications.

Excitation curves of x-ray emission lines produced by the filling of vacancies in inner shells created by electron impact can be utilized to obtain the value of the binding energy of the ejected electron. To get these values various corrections have to be applied to the raw data and certain assumptions made about the nature of the excitation curves. These points are discussed in detail. Binding energy values (with errors) for the cobalt L_{II} and L_{III}, nickel L_{II} and L_{III}, lanthanum M_{IV} and M_V, and cerium M_{IV} and M_V levels are given and compared with values obtained by more conventional methods. Binding energy differences can also be obtained from appropriate pairs of excitation curves. These differences are unaffected by some of the corrections and assumptions made in obtaining the absolute binding energies. Some binding energy differences (with errors) for cobalt, nickel, lanthanum and cerium are given and compared with more conventional values. (auth)

25622 (CONF-720404-(Vol.1), pp 730-742) EXPERIMENTAL INNER ELECTRON BINDING ENERGIES AND LIMITS ON ELECTRODYNAMIC NONLINEARITIES. Freedman, M. S.; (Argonne National Lab., Ill.); Porter, F. T.; Mann, J. B. Jan 1973.

From International Conference on Inner Shell Ionization Phenomena and Future Applications; Atlanta, Georgia, United States of America (USA) (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

Recent approximate calculations of inner shell binding energies (eigenvalues) for superheavy elements (Z = 100 to 250) were based on linear (Maxwellian; M) electrostatics and on a particular nonlinear limited-field-strength electrostatics (Born-Infeld; BI). These showed a very steep, $\sim Z^9$ dependence of the (M-BI) difference for K electrons from a small value at Z = 100 to e.g. 270 keV at Z = 164. Our K binding energy measurement in $^{257}_{100}Fm$ (141.967 ± 0.013 keV) was compared to a precision M-based relativistic Hartree-Fock calculation (J. Mann) for Fm. This "frozen-orbital" neutral atom eigenvalue, 143.051 keV, corrected for electron rearrangement, magnetic, retardation, self-energy, vacuum polarization and electron correlation effects gave a binding energy of 141.965 ± 0.025 keV. From RFG we obtained their Fm eigenvalues computed from a Thomas-Fermi atom model; viz. $E_K(M)$ = 142.83 keV (close to Mann's eigenvalue) and $E_K(BI)$ = 139.53. Analysis of the above-listed correction terms and others which convert these eigenvalues to binding energies shows it is very improbable they could radically reduce the 3.3 keV (M-BI) difference. Thus the close agreement of our experimental and M-based calculated values, which we state is within ±0.035 keV, compared to the ~3.3 keV (M-BI) difference, already indicates even at Z = 100, that linear electrostatics is a very good approximation and that any residual nonlinearities are ~ two orders of magnitude smaller than given by BI theory. (auth)

25623 (CONF-720404-(Vol.3), pp 1698-1747) SURVEY OF THE HIGH FREQUENCY SATELLITES IN X-RAY EMISSION SPECTRA. Nigam, A. N.; Mathur, R. B. (Univ. of Rajasthan, Jaipur, India). Jan 1973.

From International conference on inner shell ionization phenomena and future applications; Atlanta, Georgia, USA (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

A brief survey of the work on high frequency satellites in x-ray spectra is presented. The different theories proposed for their origin have been recalled and briefly discussed. Suitable transitions have been assigned to as many of the observed satellites as possible. The unavailability of the required energy level data has been the principal reason for not being able to assign transitions to the remaining lines. A few recent assignments have been critically examined. The final assignments have been justified by comparing the experimentally observed values of the wave lengths with those obtained on the basis of Wentzel-Druyvesteyn Theory of single electron transition in atoms with multiple inner shell ionization. A new systematic nomenclature scheme for these satellites is proposed. A suggestion has been made for the compilation of two vacancy and three vacancy energy level diagrams and some graphical exposition of regularities. (auth)

25624 (CONF-720404(Vol.4), pp 2274-2304) PRESENT AND FUTURE APPLICATIONS OF AUGER SPECTROSCOPY. Carlson, T. A. (Oak Ridge National Lab., TN). Jan 1973.

From International conference on inner shell ionization phenomena and future applications; Atlanta, Georgia (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

Because of the high scattering cross section for low energy electrons in matter, studies on the Auger effect have been somewhat limited. However, in two situations, gases at low pressures and surfaces of solids, Auger electrons may be measured with ease. During the last few years increased attention has been paid to Auger spectroscopy as a means for studying other atomic and molecular properties. With gases Auger spectroscopy has been helpful in yielding information regarding initial excitation phenomena and the nature of doubly-charged molecules, as well as providing a method for gas analysis. With solids, Auger spectroscopy has become a powerful tool for surface analysis, especially when combined with other surface techniques such as low energy electron diffraction (LEED) and scanning electron microscopy. An outline of the present uses of Auger spectroscopy will be given together with some suggestions for the future. (auth)

25625 (UCID-16095) NEW EQUATION OF STATE FOR HYDROGEN. Olness, R. J.; Graboske, H. C. Jr.; Hoover, W. G. (California Univ., Livermore. Lawrence Livermore Lab.). 2 Jun 1972. 19p. Dep. NTIS $3.00.

The new hydrogen equations of state introduced within the last few months are described including the low temperature region. (JFP)

25626 DEPENDENCE OF THE ABSOLUTE PROBABILITIES OF KLL AUGER TRANSITIONS ON THE ATOMIC NUMBER, 30 ≤ Z ≤ 94. II. Babenkov, M. I.; Bobykin, B. V.; Petukhov, V. K.

(Inst. of Nuclear Physics, Alma-Ata, USSR). Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 10, 2150-2156(Oct 1972). (In Russian).

A study was made of the absolute probabilities of KLL transitions of the elements $30 \leq Z \leq 94$ as a function of the atomic number. As part of the study, the relative intensities of KLX- and KXY groups of Auger electrons were found to have some dependence on the atomic number. Two other functions were found to be Z dependent: the fluorescent output for the K shell and the intrinsic width of the excited K level of the elements. (4 figures) (KSW)

25627 DEPENDENCE OF THE RELATIVE PROBABILITIES OF KLL AUGER TRANSITIONS ON THE ATOMIC NUMBER FOR $29 \leq Z \leq 94$. I. Babenkov, M. I.; Bobykin, B. V.; Petukhov, V. K. (Inst. of Nuclear Physics, Alma-Ata, USSR). Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 10, 2139-2149(Oct 1972). (In Russian).

A study was made of the systematized experimental data from the literature on the relative intensities of KLL-transitions (Auger) for the elements $29 \leq Z \leq 94$. A least-squares treatment of the data indicated that the relative intensities were a function of Z. (6 figures, 1 table) (tr-auth)

25628 RELATIVE INTENSITIES OF X RAYS OF THE K-SERIES FOR THE ELEMENTS Z = 79 TO 88. Vylov, Ts.; Dzhelepov, B. S.; Ivanov, R. B.; Mikhailova, M. A.; Sergeev, V. O. Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 10, 2136-2138(Oct 1972). (In Russian).

The relative intensities of the x-ray lines of Au, Hg, Tl, Pb, Po, At, Rn, Fr, and Ra were measured with a γ spectrometer with a plane-parallel Ge(Li) detector. Values for the ratios $K\alpha_2/K\alpha_1$, $K\beta_1'/K\alpha_1$, and $K\beta_2'/K\alpha_1$ were obtained, and the values for $K\alpha_2/K\alpha_1$ agreed with the theoretical values of J. H. Scofield [Phys. Rev., 179, 9 (1969)], and to within 10% of those of Wapstra et al (1960). (2 figures, 1 table) (KSW)

25629 MEASUREMENT OF THE FIRST IONIZATION POTENTIAL OF URANIUM IN A DC ARC PLASMA BURNING IN AIR. Avni, R. (Israel Atomic Energy Commission, Beersheba); Klein, F. S. pp 280-285 of Application of different spectroscopic methods to the solution of problems in chemical analysis. Vols. I and II. London; Adam Hilger Ltd. (1971).

From 16th international conference on spectroscopy; Heidelberg, Federal Republic of Germany (F. R. Germany) (4 Oct 1971). See CONF-711015-(Vols 1 and 2).

The ionization potential (V_i) of an atom in a plasma in thermodynamic equilibrium (TE) is, according to Saha, a function of the temperature (T) and the electron density (n_e). The conditions of TE in the central region for a number of different matrices are tabulated. The electron density was calculated from the energy balance, i.e., the equality between the electrical energy introduced and the heat losses, ignoring radiation losses. This calculation of average electron density n_e is independent of V_i. $\bar{n}_e$ was compared with the n_e obtained by Saha's method, i.e., relating the intensity of an ion spectral line to that of an atomic line. The following elements were introduced separately into the arc: Ba, Al, V, Cr, Zr, Mo, Cu, Si, and some rare earths. The correlation between the measured temperature and the V_i of each element is shown graphically. A similar relationship has been established between $\bar{n}_e$ and V_i. The values of T and $\bar{n}_e$ for uranium give a figure of 6.3 ± 0.3 eV for the ionization potential of uranium. (UK)

25630 RELATIVE X-RAY INTENSITIES IN THE K-SHELL. Hansen, J. S.; Freund, H. U.; Fink, R. W. (Georgia Inst. of Tech., Atlanta). pp 1329-1334 of Radioactivity in Nuclear Spectroscopy. Vol. II. Hamilton, J. H. (ed.). New York; Gordon and Breach Publishers, Inc. (1972).

From International Conference on Radioactivity in Nuclear Spectroscopy; Nashville, Tennessee, United States of America (USA) (11 Aug 1969). See CONF-690818-(Vol.2).

25631 ASPECTS OF NEOCLASSICAL RADIATION THEORY. Gibbs, D. A. St. Louis; Washington Univ. (1972). 93p. University Microfilms Order No. 73-5040.

THESIS (PH. D.).

The main objective is the study of the neoclassical equations of motion. They represent a self-consistent way of combining the Schrödinger equation for an atom with Maxwell's equations for the radiation field in the general spirit of semi-classical theory which avoids field quantization but still leads to the prediction of many effects usually associated with quantum electrodynamics. The Schrödinger current is interpreted as an actual current instead of a probability current and is used as the current source in Maxwell's equations. The resulting solutions of Maxwell's equations used in the Hamiltonian of the atom then account for the self-field of the electron. The major application considered is the neoclassical theory of the Lamb shift, a preliminary treatment of which was given by M. D. Crisp. In refining and clarifying this theory, the following points are made: The effect of the longitudinal field on the Lamb shift is calculated. It is shown that the transverse and longitudinal atomic currents have essentially the same range as the total current although they are each larger than the total current far from the atom. The neoclassical equations of motions are shown to be invariant under a gauge transformation of the electromagnetic potentials without transforming the wavefunction. The rotating wave approximation is shown to be valid for nondegenerate levels but not for degenerate levels. The effect of degeneracy on the Lamb shift and on spontaneous emission is indicated. The effect of the rest of the levels on the two level calculation is illustrated. A discussion is included on the attempts of quantum electrodynamics to duplicate neoclassical calculations. (Diss. Abstr. Int., B)

25632 RECOMBINATION RATE COEFFICIENT OF MOLECULAR HELIUM IONS IN A PULSED AFTERGLOW AT 1.86 TORR. Hicks, H. C. S. Denton, TX; North Texas State Univ. (1972). 214p. University Microfilms Order No. 73-2906.

THESIS (PH. D.).

The recombination rate coefficient for molecular helium ions has been measured in a pulsed afterglow at 1.86 Torr as a function of electron temperature and electron density without making a priori assumptions about the functional dependence. The concentrations of the molecular ions and electrons were measured and the source terms for the molecular ions were included in the rate equation. (JFP)

25633 $S_{\frac{1}{2}}$–$P_{\frac{1}{2}}$ LAMB SHIFT IN THE n = 5 STATE OF IONIZED HELIUM. Baumann, M.; Eibofner, A. (Univ., Tuebingen, Ger.). Phys. Lett., 43A: No. 2, 105-106(26 Feb 1973).

Radio frequency induced transitions between the 5 $S_{\frac{1}{2}}$ ($m = \frac{1}{2}$) and the 5 $P_{\frac{1}{2}}$ ($m = -\frac{1}{2}$) state in He^+ have been detected and a value for the 5 $S_{\frac{1}{2}}$ – 5 $P_{\frac{1}{2}}$ -Lambshift of (909.2 ± 7) MHz has been deduced, which agrees well with the theoretical value of 906.0 MHz. (auth)

25634 SUPERHEAVY ELEMENTS AND NONLINEAR ELECTRODYNAMICS. Rafelski, J. (Univ., Frankfurt am Main); Greiner, W.; Fulcher, L. P. Nuovo Cim.; 13B: No. 1, 135-160 (11 Jan 1973).

Maxwell's equations, which underlie electrodynamics, are linear equations. Nonlinear effects, such as photon–photon scattering, are known to arise in quantum electrodynamics, and one might expect them to become important in the case of strong external fields. Attention is devoted to the consequences of a class of nonlinear Lagrangians, which includes that of Born and Infeld and whose common property is that they lead to upper limits for the electric field strength (somewhat analogous to the upper limit for the velocity of a particle in special relativity). These nonlinear Lagrangians also lead to a finite electromagnetic self-energy for the electron, unlike the case of Maxwellian electrodynamics. The importance of nonlinear effects, of course, depends upon the size of the upper limit to the electric field strength. If this upper limit is determined by requiring that the mass of the electron is of an entirely electromagnetic origin, nonlinear effects become very important in determining the eigenvalues of electrons bound to superheavy nuclei. For example, the 1s energy eigenvalue is raised by 270 keV for Z = 164. The Lagrangians considered here do not lead to an absolute gap between bound states and the states of the lower continuum; the 1s energy eigenvalue becomes equal to −0.511 MeV, where the lower continuum begins, for Z = 215. An analogy between nonlinear electrodynamics and higher-order vacuum polarization corrections is studied. (7 figures, 3 tables) (auth)

Positronium, Muonium, and Muonic and Mesic Atoms and Molecules

Refer also to abstracts 24420, 25916, and 26666.

25635 (CONF-720404–(Vol.3), pp 2175-2187) INNER SHELL IONIZATION IN POSITRON ANNIHILATION. Berenyi, D. (Inst. of Nuclear Research, Debrecen, Hungary). Jan 1973.

From International conference on inner shell ionization phenomena and future applications; Atlanta, Georgia, USA (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

After surveying the theory of the internal shell ionization processes in positron annihilation (mainly single-quantum annihilation and radiationless annihilation), the experimental data are summarized in this field of topics. Finally, attention is drawn to some important problems to be investigated. (auth)

25636 (JINR-P1-6854) OBSERVATION OF A NEGATIVE INDUCTION EFFECT IN π^--MESON CAPTURE BY BOUNDED HYDROGEN. Vilgelmova, L.; Zimrot, P.; Petrukhin, V. I.; Risin, V. E.; Smirnova, L. M.; Suvorov, V. M.; Yutlandov, I. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1972. 8p. (In Russian). Dep. NTIS (U. S. Sales Only).

A negative induction effect has been observed for probability of negative pion capture by hydrogen by the ϵ suppression. The linear dependence of the ϵ suppression upon the induction constants of σ_I substitutes has been found for methyl derivatives. No similar correlation has been observed for benzol derivatives, which may be due to contribution of the conjugation effects to the ϵ suppression. (auth)

25637 MODEL-POTENTIAL THEORY OF POSITRON-ALKALI-ATOM BOUND STATES. I. Ground-state Energy and Atomic Properties. Cavaliere, P., Ferrante, G. (Univ., Palermo, Italy). Nuovo Cim.; 14B: No. 1, 127-146(11 Mar 1973).

The pseudopotential method is applied in the model-potential form to the problem of a positron bound to an alkali atom, with the ultimate goal of constructing an approximate wave function of the bound state such as to permit accurate calculations of the positron binding energy, positron annihilation rates and the angular correlation for two-photon annihilation. We develop the equations of the problem, and then calculate the ground-state energy of the positron-alkali-atom bound state and a number of geometrical expectation values, such as interparticle distances and some powers of them, angular separations, and so on. Different probability density distributions are also calculated and plotted. Due to the crucial importance of the explicit electron-positron correlation in the wave function for annihilation problems, all our calculations are performed with correlated model wave functions. (auth)

25638 MODEL-POTENTIAL THEORY OF POSITRON-ALKALI-ATOM BOUND STATES. II. Annihilation Characteristics. Cavaliere, P.; Ferrante, G. (Univ., Palermo, Italy). Nuovo Cim.; 14B: No. 1, 147-155(11 Mar 1973).

The model-potential treatment developed previously is applied to the study of the annihilation properties of a positron bound to an alkali atom. By using a model wave function for the positron bound state, accounting explicitly for electron-positron correlation, the following quantities are calculated: the electron density at the position of the positron, the spin-averaged two-photon annihilation rate, the angular correlation function of the pair of emitted photons, and the momentum distribution function of the annihilating electron–positron pair. The electronic densities at the positron and the annihilation rates result to be near the corresponding positronium values. This, together with other reported results, allows us to view the positron-alkali-atom bound state as a positronium atom moving in the field of an alkali ion and being very slightly affected by the latter. The presence of a small secondary maximum in the momentum distribution, the previous work on the subject and some limitations of the model-potential treatment are discussed in detail. (auth)

Collision Phenomena

Refer also to abstracts 25589, 25710, and 26003.

25639 (AD-750875) ABSOLUTE YIELDS OF X-RAY INDUCED PHOTOEMISSION FROM METALS. Bradford, J. N. (Air Force Cambridge Research Lab., L. G. Hanscom Field, MASS). 23 Aug 1972. 28p. (AFCRL-72-542; AFCRL-PSRP-510). NTIS.

Absolute electron yields from tantalum, molybdenum, copper and aluminum have been measured for several bombarding geometries. The photon spectra used were derived from filtered bremsstrahlung generated in a tungsten anode at 50 kV, constant potential. The electron spectra were measured by a cylindrical electrostatic analyzer with a secondary emission detector. The spectra exhibit both Auger and scattered photoelectrons. The electron current densities arising from these spectra constitute source functions for vulnerability studies on systems exposed to internal electromagnetic pulse (IEMP) effects arising from nuclear environments. (auth) (NTIS)

25640 (CEA-CONF-2135) DISTORTION OF ATOMIC STRUCTURE IN HIGH-INTENSITY LASER FIELDS. Papoular, R.; Platz, P. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). 1972. 43p. (CONF-720976-1). Dep. NTIS (U.S. Sales Only).

From Conference on interaction of electrons with strong electromagnetic field; Balatonfuered, Hungary (11 Sep 1972).

The theory for dynamic Stark effect in laser–atom interactions is discussed. The spectral shifts induced in mercury by lasers are described experimentally. (JFP)

25641 (CONF-720404–(Vol.1), pp 414-416) X-RAY EMISSION CROSS SECTIONS AND FLUORESCENCE YIELDS FOR LIGHT ATOMS AND MOLECULES BY ELECTRON IMPACT. Harrison, K. G.; Tawara, H.; de Heer, F. J.; Saris, F. W. (FOM, Instituut voor Atoom- en Molecuulfysica, Kruislaan, Amsterdam). Jan 1973.

From International conference on inner shell ionization phenomena and future applications; Atlanta, Georgia, USA (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

The cross sections for K-shell x-ray emission were measured for 0.2-to-18-keV electrons incident on methane, nitrogen, oxygen, neon, and argon. The fluorescence yields are found. No dependence of these yields on incident energy was found. (JFP)

25642 (CONF-720404–(Vol.1), pp 743-756) HIGH RESOLUTION MEASUREMENTS OF AUGER-ELECTRON AND PHOTOELECTRON STRUCTURE IN THE SECONDARY-ELECTRON ENERGY DISTRIBUTIONS OF ALUMINUM, NICKEL, AND COPPER. Powell, C. J. (National Bureau of Standards, Washington, DC). Jan 1973.

From International conference on inner shell ionization phenomena and future applications; Atlanta, Georgia, USA (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

Measurements are reported of selected structure in the secondary electron energy distributions of evaporated aluminum, nickel and copper. The specimens were bombarded with 3 keV electrons and the secondary structure was measured with a resolution of 0.1 eV. For each metal, attention was given primarily to data that could give information on the valence-band density of states. Attempts were made to observe the $AlKL_{2,3}M$ Auger-electron energy distribution expected at about 1470 eV. Structure was, however, observed with a high energy edge of 1485.9 ± 0.5 eV and a breadth of 8 to 9 eV. This structure was interpreted as being due to photoemission of valence electrons by internally generated $K\alpha$ x-rays and was similar to uv photoelectron distributions and to the calculated density of states. Inelastic scattering of the photoelectrons obscures the expected $AlKL_{2,3}M$ structure. Auger electron peaks in the ranges 730 to 800 eV and 820 to 865 eV were measured in the energy spectra for nickel and copper, respectively. Structure was observed in the $L_3M_{2,3}M_{4,5}$ transition which could be associated in part with solid-state effects and in part with the final atomic states of each element. Density-of-states data could not be derived from the Auger spectra without more detailed knowledge of the final states expected after the Auger transition of interest. (auth)

25643 (CONF-720404-(Vol.2)) PROCEEDINGS OF THE INTERNATIONAL CONFERENCE ON INNER SHELL IONIZATION PHENOMENA AND FUTURE APPLICATIONS, APRIL 17–22, 1972, ATLANTA, GEORGIA. Volume 2. Fink, R. W.; Manson, S. T.; Palms, J. M.; Rao, P. V. (eds.) (Georgia Inst. of Tech., Atlanta; Emory Univ., Atlanta, GA). Jan 1973. 695p. Dep. NTIS.

From International Conference on Inner Shell Ionization Phenomena and Future Applications; Atlanta, Georgia, United States of America (USA) (17 Apr 1972).

The conference included 43 papers seven of which were abstracted previously in NSA. For abstracts of these papers see CONF-720404(Vol.2) in a cumulative report number index. Separate abstracts were prepared for 36 papers. (JFP)

For abstracts of individual papers see: 25644–25678, and 25716.

25644 (CONF-720404–(Vol.2), pp 816-880) MEASUREMENT OF INNER SHELL IONIZATION CROSS SECTIONS FOR THE 100 TO 1000 eV REGION AS INVOLVED WITH X-RAY AND ELECTRON INTERACTIONS WITHIN SOLIDS. Henke, B. L. (Univ. of Hawaii, Honolulu). Jan 1973.

From International conference on inner shell ionization phenomena and future applications; Atlanta, Georgia, USA (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

In the low energy region (100 to 1000 eV) the measurement of photoelectric or electron–electron cross sections for atomic systems within solids is generally very difficult. Nevertheless, the transmission of monochromatic x rays or of monoenergetic (no-loss) electrons is almost completely determined by these cross sections in this energy region. Important new techniques for the analysis of surface chemistry and structure can be applied quantitatively, provided that the ionization processes are sufficiently well understood that their cross sections can be established. Only recently has an appreciable amount of ultra-

soft x-ray absorption data become available. Primary electron attenuation data in this low energy region are nearly nonexistent. In the work described here, x-ray cross sections have been measured by both transmission and reflection; electron ionization cross sections have been measured by photoelectron spectroscopy. An important characteristic of low energy photoelectron spectroscopy is that only a few atomic layers are involved in the x-ray or electron interactions being measured. The general problem of experimentally determining ionization cross sections for the 100 to 1000 eV region is discussed. (auth)

25645 (CONF-720404-(Vol.2), pp 881-885) IONIZATION OF RARE GAS ATOMS IN THE BORN AND EIKONAL APPROXIMATIONS. Wallace, S. J.; Berg, R. A.; Green, A. E. S. (Univ. of Florida, Gainesville). Jan 1973.

From International conference on inner shell ionization phenomena and future applications; Atlanta, Georgia, USA (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

The analytic independent particle model of Green, Sellin and Zachor is employed to obtain atomic bound and continuum state wave functions needed in calculations of the ionization form factor. Cross sections are presented for inner and outer shells of Ar using both the Born approximation and an eikonal/closure approximation. This latter approximation is similar to Glauber theory but expressly accounts for inelasticity in the ionizing reaction. The eikonal/closure approximation is shown to account for experimental total cross sections at much lower energy than the Born approximation. The theory is calculationally very simple in the single scattering limit since a universal factor is obtained which effectively unitarizes the Born approximation result. (auth)

25646 (CONF-720404-(Vol.2), pp 886-896) INNER-SHELL EXCITATIONS IN SOLIDS DUE TO HIGH ENERGY ELECTRONS AND APPLICATIONS TO CHEMICAL ANALYSIS. Colliex, C.; Jouffrey, B. (Faculte des Sciences, Orsay, France). Jan 1973.

From International conference on inner shell ionization phenomena and future applications; Atlanta, Georgia, USA (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

The inelastic scattering of fast electrons due to the excitation of deep atomic electrons has been studied experimentally with an electron microscope equipped with a Castaing-Henry energy filter. From these measurements, we have obtained information about the electronic density of states well above the Fermi level, we have deduced the differential and total scattering cross sections of high energy electrons associated with an inner shell excitation. Finally we discuss how these phenomena can be used to develop a chemical analysis technique. (auth)

25647 (CONF-720404-(Vol.2), pp 908-914) PRODUCTION OF METASTABLE IONS IN ELECTRON-CESIUM ATOM COLLISIONS. Hahn, Y. B.; Nygaard, K. J. (Univ. of Missouri, Rolla). Jan 1973.

From International conference on inner shell ionization phenomena and future applications; Atlanta, Georgia, USA (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

The structure in the electron impact ionization cross section in cesium can be partially accounted for by the mechanisms of autoionization and excitation-ionization of 5p-electrons. For electron energies above 17 eV a large fraction of the ions are metastable and can be detected by Auger emission from a metal surface. The experiment was performed in a crossed cesium atom-electron beam apparatus, and the metastable ions were counted with a Channeltron. The metastable ion count rate was a factor of 100 higher than that due to photons from atomic and ionic transitions. We have identified the $5d\{[1\frac{1}{2}],1\}$- and $5d\{[3\frac{1}{2}],3\}$-levels of CsII, and measured the overall excitation function for these levels. (auth)

25648 (CONF-720404-(Vol.2), pp 915-935) INNER SHELL IONIZATION BY SIMPLE CHARGED PARTICLES. Merzbacher, E. (Univ. of North Carolina, Chapel Hill). Jan 1973.

From International conference on inner shell ionization phenomena and future applications; Atlanta, Georgia, USA (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

Inelastic collisions of heavy charged particles with atoms leading to the excitation and ionization of inner shells have been classified in two broad categories depending on the degree of violence of the collision. The slow collisions between ions and atoms, in which x rays may be produced in prodigious quantities, are usually interpreted in terms of the Fano-Lichten model of transitions between individual electronic orbitals in a transient diatomic molecular structure. Strong coupling of deep lying levels, consistent with the exclusion principle, is assumed to be responsible for the excitation of electrons in this picture, which may be contrasted with the direct collision between a swiftly moving incident charged particle and a tightly bound atomic electron leading to the creation of a vacancy in one of the inner shells. This paper deals exclusively with the direct collision process, in which the Coulomb interaction between a simple charged particle, moving too fast to capture electrons appreciably, provides the perturbation that causes a transition between the unperturbed levels of the target atom. (auth)

25649 (CONF-720404-(Vol.2), pp 936-947) IMPACT PARAMETER DESCRIPTION OF INNER SHELL COULOMB IONIZATION BY HEAVY PROJECTILES. Hansteen, J. M.; Mosebekk, O. P. (Univ. of Bergen, Norway). Jan 1973.

From International conference on inner shell ionization phenomena and future applications; Atlanta, Georgia, USA (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

Recent experimental results have necessitated further studies of atomic Coulomb ionization by heavy, charged projectiles such as protons, deuterons, alpha particles, etc. Assuming straight line paths for the impinging particles, the method is shown to be valid for all projectile energies, limited only in the adiabatic region by deflection effects and in the diabatic region by relativistic effects. Impact parameter dependencies and total cross sections are evaluated and discussed for various electron shells and targets. Based on the impact parameter dependence of the differential cross section it is attempted to explain the variation with the projectile energy of the total cross section for the different L-subshells. It is suggested that further experiments to test the validity of the semi-classical method be made. (auth)

25650 (CONF-720404-(Vol.2), pp 948-978) K-SHELL IONIZATION IN ION-ATOM COLLISIONS. Brandt, W. (New York Univ., NY). Jan 1973.

From International conference on inner shell ionization phenomena and future applications; Atlanta, Georgia, USA (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

Recent progress in the study of this phenomenon has brought detailed understanding of the first of two possible ionization processes. Under conditions where the projectiles act as bare charged mass points, only Coulomb excitation of the target K-shell electrons can occur. The Coulomb K-shell ionization cross sections per unit projectile charge agree in detail with comprehensive theoretical predictions that incorporate effects of the finite projectile charge on the collision partners. Projectiles with atomic number comparable to or larger than that of the target atoms carry an electron cloud into the encounter at velocities small compared to the relevant projectile-electron velocities. This causes Pauli excitation of atomic shells through the exchange forces set up in the overlapping clouds. Coulomb and Pauli excitation differ in basic ways and can give rise to quantitatively widely different K-shell ionization cross sections with distinct collision-energy dependences. Published and new experimental data exhibit such distinguishing trends. (auth)

25651 (CONF-720404-(Vol.2), pp 979-992) K-SHELL IONIZATION BY FAST PROTONS. Toburen, L. H. (Battelle Northwest Lab., Richland, WA). Jan 1973.

From International conference on inner shell ionization phenomena and future applications; Atlanta, Georgia, USA (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

Cross sections for K-Shell ionization of elements from boron to neon are presented for proton energies from 0.3 to 2.0 MeV. These cross sections were obtained from measured K-Auger electron yields with the assumption that the fluorescent yield is negligible. For these elements, neglecting de-excitation by X-ray fluorescence will effect the ionization cross sections by less than 2%. The K-Shell ionization cross sections obtained in this way are in good agreement with calculated values based on an impulse approximation. A comparison of the measured cross sections with the results of a Born calculation shows that the Born cross sections are nearly 30% smaller than the measured values. In the case of carbon, where published X-ray production cross sections are available, an estimate of the fluorescent yield can be obtained by combining the Auger-electron and X-ray production cross sections. The fluorescent yield determined from these data was

found to increase from 0.0016 to 0.0025 as the proton energy increased from 0.3 to 2.0 MeV. This increase is indicative of multiple ionization and suggests the need to redefine the fluorescent yield in terms of initial and final states of the target atom. This variation also contributes to the difficulty in obtaining accurate K-Shell ionization cross sections from X-ray yield measurements for heavy particle impact. (auth)

25652 (CONF-720404-(Vol.2), pp 993-997) K X-RAYS PRODUCED BY 2 TO 14 MeV PROTON BOMBARDMENT OF THIN CARBON FOILS. Bissinger, G. (Rutgers Univ., New Brunswick, NJ); Kugel, H. W. Jan 1973.

From International conference on inner shell ionization phenomena and future applications; Atlanta, Georgia, USA (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

Proton-induced carbon K x-ray yields have been measured with a gas flow proportional counter for 2 to 14 MeV protons on a thin C target (50 $\mu g/cm^2$). The K hole production cross section derived from these measurements agrees with the expected theoretical ln (Ep)/Ep energy dependence at projectile energies considerably above the maximum (~.5 MeV) in this cross section. (auth)

25653 (CONF-720404-(Vol.2), pp 998-1018) X-RAY PRODUCTION CROSS SECTIONS VIA PROTON AND ALPHA PARTICLE BOMBARDMENT. Lin, J. (Tennessee Technological Univ., Cookeville); Duggan, J. L.; Carlton, R. F. Jan 1973.

From International conference on inner shell ionization phenomena and future applications; Atlanta, Georgia, USA (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

K shell ionization cross sections induced by charged particles have been measured for a number of elements for incident protons and alpha particles. These cross-sections have been measured for Ca, Ti, Fe, Co, Ni, Zn, Cu, and Ag for incident alpha energies in the range from 2 to 12 MeV. Yield curves were also measured for Ti, Fe, Co, Ni, Ge, and Ag for incident protons in the range from 1 to 6 MeV. A high resolution Si(Li) (166 eV at 5.9 keV) detector was used to measure the x-rays from these elements. The results are compared to the plane wave Born approximation theory proposed by Merzbacher and Lewis and to the binary encounter approximation recently proposed by Garcia for an interaction of this type. Since many of the same elements were used for both protons and alpha particle bombardment, a critical test of the Z^2 dependence of cross section for (1+) and (2+) charged particles is also obtained from the data. (auth)

25654 (CONF-720404-(Vol.2), pp 1019-1035) IMPACT PARAMETER DEPENDENCE OF K-SHELL IONIZATION. Laegsgaard, E.; Andersen, J. U. (Aarhus Univ., Denmark); Feldman, L. C. Jan 1973.

From International conference on inner shell ionization phenomena and future applications; Atlanta, Georgia, USA (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

The impact parameter dependence of K-shell ionization by energetic protons is inferred from a measurement of the angular distribution of scattered particles coincident with a K-x-ray. Results for 1- and 2-MeV protons on Cu, Se, and Ag are reported. In general the measured impact parameter dependence as well as the total cross section agree with calculations based on a semi-classical impact parameter formulation. (auth)

25655 (CONF-720404-(Vol.2), pp 1036-1042) OBSERVATION OF INELASTIC PROTONS CORRESPONDING TO K-SHELL IONIZATION OF Pb BY 10 AND 14 MeV PROTONS. Bissinger, G. (Rutgers Univ., New Brunswick, NJ); Kruse, T. H.; Williams, M. E.; Savin, W. Jan 1973.

From International conference on inner shell ionization phenomena and future applications; Atlanta, Georgia, USA (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

The inelastic proton group corresponding to Pb K shell ionization has been observed for 10 and 14 MeV protons at lab angles of 12 and 10° respectively, using thin ^{206}Pb targets evaporated onto C foil. The protons were detected with a position sensitive Si surface barrier detector mounted at the focal plane of a magnetic spectrograph. For the impact parameters of $\sim 5 \times 10^{-12}$ cm achieved in this experiment, measured values of the ionization probability I_p were $(4.5 \pm 1.2) \times 10^{-5}$ and $(5.1 \pm 1.2) \times 10^{-5}$ at 10 and 14 MeV, respectively. (auth)

25656 (CONF-720404-(Vol.2), pp 1043-1056) CROSS SECTIONS FOR INNER SHELL IONIZATION OF GASEOUS MOLECULES BY 50 TO 500 keV PROTONS. Stolterfoht, N. (Hahn-Meitner-Institut fuer Kernforschung Berlin GmbH, Berlin, Ger.). Jan 1973.

From International conference on inner shell ionization phenomena and future applications; Atlanta, Georgia, USA (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

Absolute cross sections for Auger electron emission were measured by 50 to 500 keV proton impact on N_2, CO_2, and CH_4 using a molecular beam of some 10^{-3} Torr in the scattering volume. The Auger electrons were analyzed with medium resolution of 0.3 to 1% (FWHM) by an electrostatic parallel plate spectrometer movable in the angular range of 18 to 155° with respect to the proton beam. The isotropic angular distribution of the K-shell Auger electrons was confirmed. In general several groups of Auger transitions were well resolved. The significant variation of relative peak heights with proton energy allowed for identification of satellite lines due to initial double ionization. Corresponding lines were integrated to obtain total cross sections for the production of inner shell vacancies by proton impact as a function of the proton energy, whereby a good agreement was found with binary encounter calculation by Garcia. (auth)

25657 (CONF-720404-(Vol.2), pp 1057-1068) K AND L SHELL IONIZATION ARISING FROM 2 TO 30 MeV PROTON BOMBARDMENT OF Ag. Shafroth, S. M. (Univ. of North Carolina, Chapel Hill); Bissinger, G. A. Jan 1973.

From International conference on inner shell ionization phenomena and future applications; Atlanta, Georgia, USA (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

A thin (31 μcm) Ag foil was bombarded with protons from 2 to 30 MeV using the TUNL Cycio-Graaff to produce the required nanoamp proton beams. K and L x rays were detected using a cooled Si(Li) detector. The absolute K and L shell ionization cross sections, σ_K and σ_L, extracted from these measurements have been compared to plane wave Born approximation calculations (PWBA) of Khandelwahl, Choi and Merzbacher and to binary-encounter approximation calculations of Garcia and agree quite well with both over the energy range from 2 to 30 MeV. (auth)

25658 (CONF-720404-(Vol.2), pp 1069-1079) EXPERIMENTAL DETERMINATION OF CROSS SECTIONS FOR THE PRODUCTION OF X-RAYS OF ARGON AND KRYPTON BY 1.5 TO 4.0 MeV PROTONS. Winters, L.; Ellsworth, L. D.; Chiao, T.; Macdonald, J. R. (Kansas State Univ., Manhattan). Jan 1973.

From international conference on inner shell ionization phenomena and future applications; Atlanta, Georgia, USA (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

A Si(Li) X ray detector has been used to observe the de-excitation of atoms of argon and krypton bombarded by protons with energies of 1.5 to 4 MeV. Cross sections for the production of K-shell x rays of argon and K- and L-shell x rays of krypton have been determined by measuring yields as a function of gas target thickness at pressures in the neighborhood of 1 micron. In general, the X ray yield is proportional to pressure below 8 microns. A preliminary analysis of the data reveals that the shapes of the excitation functions are in agreement with theoretical predictions based on the Born approximation but that the experimental points lie consistently lower than the theoretical ones. Agreement between theory and experiment is better for krypton K-shell X rays than for argon. For the L-shell of krypton, experimental ionization cross sections are sensitive to the choice of fluorescence yield. Cross sections obtained using recent theoretical calculations of the fluorescence yield are 3 to 6 times greater than those obtained using earlier experimental values. The best agreement with theory is obtained by using the theoretical fluorescence yields. (auth)

25659 (CONF-720404-(Vol.2), pp 1080-1092) EXCITATION OF Au L X RAYS, E_p 2 TO 30 MeV AND Au K AND M X RAYS, E_p 2 TO 15 MeV. Waltner, A. W. (North Carolina State Univ., Raleigh); Peterson, D. M.; Bissinger, G. A.; Baskin, A. B.; Busch, C. E.; Nettles, P. H.; Scates, W. R.; Shafroth, S. M. Jan 1973.

From International conference on inner shell ionization phenomena and future applications; Atlanta, Georgia, USA (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

The production cross section for K and L x rays arising from proton bombardment of Au has been measured over an energy range of 2 to 30 MeV for L x rays and from 2 to 15 MeV for K x rays. The $L_{x\,ray}$ experiments made use of the proton beam of the TUNL Cyclo-Graaff and the K and M x-ray experiments made use of the TUNL Tandem Van de Graaff. The L x-ray component yields were determined using a Si(Li) detector and the ratios $L\alpha/L\beta$ and $L\alpha/L\gamma$ were determined over the energy range of 2 to 30 MeV. These ratios were found to be functions of energy, which become essentially constant at 10 MeV, in best agreement with the plane wave Born approximation (PWBA) calculations. The K x-ray components were measured with a high resolution Ge(Li) detector and the ratios $K\alpha_2/K\alpha_1$, $K\beta_1/K\alpha_1$ and $K\beta_2/K\alpha_1$ were obtained and compared with tabulated results. All the ratios were found to be independent of energy except $K\beta_2/K\alpha_1$ which increased with increasing energy. The component of the K and L x rays were summed to provide experimental values for the total K and L production cross sections, and these results were compared with theoretical predictions. The trend of the M x ray yield data versus E_p agreed well with new PWBA calculations of Choi. (auth)

25660 (CONF-720404-(Vol.2), pp 1093-1101) CALCULATION OF RELATIVISTIC L-SUBSHELL IONIZATION CROSS SECTIONS BY HEAVY CHARGED PARTICLE IMPACT. Choi, B. H. (Univ. of North Carolina, Chapel Hill). Jan 1973.

From International conference on inner shell ionization phenomena and future applications; Atlanta, Georgia, USA (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

L subshell ionization cross sections by an incident heavy but slow charged particle were evaluated. Incident particles are described in the plane wave Born approximation and relativistic wave functions are used for the bound and free atomic electrons. Numerical results are presented for proton impact on holmium and gold. Relative ratios of each L subshell ionization cross sections are compared with other calculations. (auth)

25661 (CONF-720404-(Vol.2), pp 1102-1112) L X-RAY PRODUCTION CROSS SECTIONS FOR 0.5 TO 3.0 MeV PROTON BOMBARDMENT OF Au. Bissinger, G. A. (Univ. of North Carolina, Chapel Hill); Baskin, A. B.; Choi, B. H.; Shafroth, S. M. Jan 1973.

From International conference on inner shell ionization phenomena and future applications; Atlanta, Georgia, USA (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

The Au L_α, L_β and L_γ yields have been measured for 0.5 to 3.0 MeV protons on a thin Au target. The L_α/L_β and L_α/L_γ ratios reach maxima for $E_p \approx 1$ MeV, while the L_γ centroid energy reaches a minimum for $E_p \approx 1.5$ MeV. Theoretical calculations of these ratios and centroid energies employ ratios of the subshell ionization cross sections, which tend at least partially to cancel Coulomb deflection, target electron polarization and binding effects. The results are compared to the binary encounter approximation and plane wave Born approximation (PWBA) theories, the latter using both relativistic and nonrelativistic wave functions for the target electrons, as well as the calculations of Hansteen and Mosebekk who correct for Coulomb deflection of the incident proton. The relativistic PWBA calculations are in significantly better agreement with experimental results for the intensity ratios. The L x-ray production cross section results are also presented and compared with theory. (auth)

25662 (CONF-720404-(Vol.2), pp 1113-1129) INNER SHELL PHOTOIONIZATION ABOVE 10 keV. Pratt, R. H. (Univ. of Pittsburgh, PA). Jan 1973.

From International Conference on Inner Shell Ionization Phenomena and Future Applications; Atlanta, Georgia, United States of America (USA) (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

The absorption of a photon of energy above about 10 keV by an atom, resulting in ejection of an inner shell electron, is well described in a one-electron approximation which replaces the atom by a central spherically symmetric potential in which the electron moves. Theoretical predictions obtained numerically beginning with Hartree–Fock–Slater type screened central potentials are believed accurate to a few percent and agree with experimental measurements of similar accuracy. The greatest uncertainties occur for light atoms, which are more sensitive to the choice of atomic model, and for low energies, when also the approximation of an atom by a central potential becomes less satisfactory. There are technical difficulties in carrying out the numerical calculations for high energy photons, and for this reason more substantial uncertainties also remain at present above about 3 MeV. We briefly describe the numerical techniques on which our present detailed understanding of atomic photoelectric effect are based, and we note the substantial differences from earlier calculations based on Born approximation, or a point Coulomb potential, or an effective-charge screening theory, or an ad-hoc deduction of higher shell effects from K shell results. We compare the present theoretical and experimental data, and the estimated accuracy of each, as a function of energy and atomic number. For this purpose we also examine the accuracy of photoeffect cross sections that can be deduced from total attenuation measurements of specified accuracy. We now know that the dominant region in configuration space for the photoeffect at these energies lies inside the atomic electron cloud at electron Compton wave length distances. We discuss the reasons for this and the striking consequences that follow from it: screening appears simply as a normalization effect with shapes of angular distributions and polarization correlations independent of screening; ratios of cross sections for certain shells are independent of energy. Problems which remain are summarized. (auth)

25663 (CONF-720404-(Vol.2), pp 1130-1141) INFLUENCE OF THE ELECTRON–HOLE EXCHANGE INTERACTION ON THE PHOTOIONIZATION CROSS SECTIONS OF 4d AND 5d SUBSHELLS. Combet Farnoux, F. (Paris Univ., Orsay, France). Jan 1973.

From International Conference on Inner Shell Ionization Phenomena and Future Applications; Atlanta, Georgia, United States of America (USA) (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

We have performed calculations including final state correlations (intrachannel interactions) to determine photoionization cross sections relative to 4d and 5d subshells for atoms with $47 \leq Z \leq 57$ (σ_{4d}) and $79 \leq Z \leq 90$ (σ_{5d}). We point out that for $Z < 56$ and $Z < 88$, the resonance maxima are flattened and their energy positions raised further, when compared with the previous results obtained from a simple central potential model. On the contrary, for Ba and La (Z = 56,57) and Ra,Th (Z = 88,90), the absorption peaks draw nearer to the thresholds and are sharper. It does not seem that this last behavior can be extended for all the lanthanides and actinides, by starting from our model, which is not convenient to account for the broad absorption peaks observed above the ionization threshold, when these are understood in terms of the autoionization of the configuration nd^9 nf^{N+1} to nd^9 $nf^N \epsilon f$. (auth)

25664 (CONF-720404-(Vol.2), pp 1175-1187) K-, L-, AND M-SHELL EXCITATION BY HEAVY ION BOMBARDMENT. Smith, F. T.; Lorents, D. C.; Olson, R. E. (Stanford Research Inst., Menlo Park, CA). Jan 1973.

From International Conference on Inner Shell Ionization Phenomena and Future Applications; Atlanta, Georgia, United States of America (USA) (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

Electronic excitation in heavy-particle collisions is discussed with particular attention to comparing conditions prevailing in inner shell excitation at high energies with outer shell excitation at low energies. The similarities greatly outweigh the differences, and the latter can be simply described and taken into account. The physical basis is described for a number of different excitation mechanisms, all of which may be seen either in inner shells or outer shells. (auth)

25665 (CONF-720404-(Vol.2), pp 1188-1208) IONIZATION AND ENERGY LOSS IN HEAVY ION–ATOM COLLISIONS. Fastrup, B. (Univ. of Aarhus, Denmark). Jan 1973.

From International Conference on Inner Shell Ionization Phenomena and Future Applications; Atlanta, Georgia, United States of America (USA) (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

Heavy ion-atom collisions at large scattering angles and moderate nuclear velocities have been shown to be very efficient for the production of inner-shell vacancies. The production cross section, which depends strongly on the distance of closest approach in the collision, indicates that the inner-shell vacancies are produced by a molecular promotion mechanism. Differential energy-loss measurements, whereby the inelastic energy loss Q is determined against the distance of closest approach in the collision, provide detailed information on the active promotion mechanism. Examples of such measurements will be given. (auth)

25666 (CONF-720404-(Vol.2), pp 1209-1222) IMPACT PARAMETER DEPENDENCE OF K-SHELL EXCITATION IN ION-ATOM COLLISIONS. Briggs, J. S. (AERE, Harwell, Eng.). Jan 1973.

From International Conference on Inner Shell Ionization Phenomena and Future Applications; Atlanta, Georgia, United States of America (USA) (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

The production of K-shell vacancies in collisions involving first-row atoms and ions has been attributed to the transfer of an electron from a $2p\sigma$ orbital to an empty $2p\pi$ orbital of the quasi-molecule formed during the collision. Recently, a quantitative discussion of symmetric collisions has been given which indicates that this process can account for the observed K-shell vacancy production cross section in Ne^+-Ne collisions. These calculations have now been extended to compare with measurements of the probability of vacancy formation as a function of distance of approach, made by Fastrup et al. The systematic variation of this probability and the total cross section as a function of impact velocity has also been considered for a variety of collision partners. The calculations have all been performed within the impact parameter formalism, assuming different forms for the inter-atomic potential. There are significant differences in the behavior of the impact-parameter-dependent probability and the total cross section for the different trajectories. (auth)

25667 (CONF-720404-(Vol.2), pp 1223-1231) CHARACTERISTIC X-RAY GENERATION DURING HEAVY ION BOMBARDMENT OF SOLIDS: ANALYSIS OF ABSORBED SURFACE LAYERS; PROJECTILE CHARGE-STATE EFFECTS. Cairns, J. A. (AERE, Harwell, Eng.). Jan 1973.

From International Conference on Inner Shell Ionization Phenomena and Future Applications; Atlanta, Georgia, United States of America (USA) (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

It is shown that the use of heavy ion bombardment offers the prospect of very considerable analytical sensitivity for the detection of elements at, or near to, solid surfaces. The fundamental considerations of this approach are illustrated by the use of some recent studies which were initiated by the appearance of some unexpected ultra-soft x-rays during Ne^+ bombardment of a series of metallic specimens, and culminated not only in the identification of sulphur as a surface contaminant, but also provided interesting indications of the potential of heavy ion irradiation for surface analysis. It is shown that the characteristic x-ray yields observed by heavy ion irradiation of a variety of solids at very low beam currents is dependent on the charge state of the projectile. This effect indicates the importance of the solid surface in establishing charge state equilibrium. (auth)

25668 (CONF-720404-(Vol.2), pp 1232-1254) SCATTERING AND ATOM-ATOM POTENTIAL CURVES AT SMALL DISTANCES. Gordeev, Yu. S. (Ioffe Physico-Technical Inst., Leningrad). Jan 1973.

From International conference on inner shell ionization phenomena and future applications; Atlanta, Georgia, USA (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

The relation of differential scattering cross section $(d\sigma/d\omega)$ (θ) with potential U(R) in collisions of atomic particles with keV energies is considered. In the case of single-channel (elastic) scattering the potential can be found from the experimental differential cross section. In the case of multichannel scattering, the investigation of the differential cross section and inelastic energy loss permits one to find the terms of the system if the number of the terms is not large. In the case of close collisions when inner shells overlap the number of interacting terms is very large. The model replacing a complicated system of real terms by a few effective terms is discussed. Each of these effective terms describes a group of energetically close transitions. The calculation of scattering cross sections for two crossing terms is given. The model of crossing effective terms explains qualitatively the peculiarities in the scattering experimentally observed. The probability of transition in the crossing of two bands of real terms is considered. It is shown that the system moves chiefly along the terms of the band where the number of terms is larger. Within the framework of this model the effective terms can be found from experimental data on scattering and inelastic energy loss. The model of crossing bands accounts for the applicability of adiabatic potentials to describing the kinematics of inelastic scattering in close collisions. Investigation of scattering processes is one of the important methods for obtaining information about the potential of atom-atom interaction at different internuclear distances. At small distances, where the potential energy of repulsion exceeds 10 eV, scattering is the only experimental way for studying the atom-atom potential U(R). (auth)

25669 (CONF-720404-(Vol.2), pp 1255-1282) RADIATIVE TRANSITIONS BETWEEN TRANSIENT MOLECULAR ORBITALS IN ATOMIC COLLISIONS. Saris, F. W. (Atomic Energy of Canada Ltd., Chalk River, Ontario); Mitchell, I. V.; Santry, D. C.; Davies, J. A.; Laubert, R. Jan 1973.

From International Conference on Inner Shell Ionization Phenomena and Future Applications; Atlanta, Georgia, United States of America (USA) (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

Inner-shell vacancies are efficiently produced in heavy-ion-atom collisions. The decay of these vacancies is expected to occur from discrete, atomic states, after the colliding atoms have separated. However recently the observation was reported of an x-ray band which could not be identified as a characteristic x-ray of either the target or the projectile atoms. This new x-ray, it was speculated, originated from the radiative filling of a vacancy in the $2p\pi$ MO of Ar-Ar system during the collision. These results and conjectures are summarized along with the presentation of further experimental evidence for the observation of radiative transitions between transient molecular orbitals of both symmetric and asymmetric systems. (auth)

25670 (CONF-720404-(Vol.2), pp 1297-1319) ENERGY LOSS AND IONIZATION IN FAST ION-ATOM COLLISIONS. Afrosimov, V. V. (Ioffe Physico-Technical Inst., Leningrad). Jan 1973.

From International conference on inner shell ionization phenomena and future applications; Atlanta, Georgia, USA (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

The review of energy loss and ionization in ion-atom collisions covers inelastic energy losses, energy losses and ionization due to excitation of outer and inner shells, decay of states with inner vacancies, the lifetime of excited states, approximation of molecular orbitals for electron transitions in term interactions, and the many-state interaction. (JFP)

25671 (CONF-720404-(Vol.2), pp 1320-1331) VACANCY PRODUCTION IN RARE-GAS ATOMS BY 0^+ IMPACT AT 50 TO 200 KeV. Bingham, F. W. (Sandia Labs., Albuquerque, NM). Jan 1973.

From International Conference on Inner Shell Ionization Phenomena and Future Applications; Atlanta, Georgia, United States of America (USA) (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

A series of experiments using delayed-coincidence techniques has provided systematic information concerning the production of vacancies in rare-gas atoms by 0^+ impact at 50 to 200 keV. A large part of these data consists of studies of the behavior of Q (kinetic energy loss) as a function of r_0 (distance of closest approach). In some regions of r_0 the $Q(r_0)$ function exhibits sharp rises or becomes double-valued; these phenomena signal the occurrence of inner-shell excitation to high levels. In 0^+-Ar collisions one or both of these phenomena occur near r_0 values of 0.19, 0.09, and 0.05 Å; in 0^+-Xe collisions, near 0.16, 0.09, and 0.06 Å; and in 0^+-Ne collisions, near 0.09 and, possibly, 0.05 Å. All these r_0 values support the hypothesis that inner-shell vacancies begin to occur when the nucleus of one of the colliding atoms penetrates approximately halfway into the unperturbed electron density corresponding to an inner shell of its collision partner. (auth)

25672 (CONF-720404-(Vol.2), pp 1348-1373) CROSS SECTIONS FOR K, L, AND M X-RAY PRODUCTION BY COLLISIONS OF 10 TO 156 MeV Cl, Br, AND I IONS WITH VARIOUS TARGETS. Schnopper, H. W. (MIT, Cambridge, MA); Sohval, A. R.; Betz, H. D.; Delvaille, J. P.; Kalata, K.; Jones, K. W.; Wegner, H. E. Jan 1973.

From International Conference on Inner Shell Ionization Phenomena and Future Applications; Atlanta, Georgia, United States of America (USA) (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

Cross sections have been obtained from x-ray spectra recorded during the interaction of Cl, Br, and I incident on a variety of thick and thin targets. The projectile energies range from 10 to 156 MeV. The targets are oriented at 45° to the beam direction and the x-rays are detected with a Si(Li) detector oriented at 90° to the beam direction. Two main amplifiers, each with a different

gain setting, are driven by the detector preamplifier output. Thus, two spectra, each covering a different energy range, are recorded simultaneously. The first covers a range from 0.5 to 16 keV and the second from 2 to 64 keV, both subject to the energy dependence of the transmission efficiency of the Be entrance window and the detection efficiency of the Si(Li) detector. The integrated number of counts under each line or band of lines is used where possible to determine the relative cross section for K, L, or M x-ray production for each choice of target, projectile and energy. Two Si particle detectors whose angles with respect to the beam direction can be varied are used to collect scattered and recoil particles. Data from the particle detectors and direct measurements of the beam current are used to determine absolute cross sections. (auth)

25673 (CONF-720404-(Vol.2), pp 1374-1387) ENERGY SHIFTS OF K, L, AND M X-RAY LINES PRODUCED BY COLLISIONS OF 10 TO 156 MeV Cl, Br, AND I IONS ON VARIOUS TARGETS. Betz, H. D. (MIT, Cambridge, MA); Delvaille, J. P.; Kalata, K.; Schnopper, H. W.; Sohval, A. R.; Jones, K. W.; Wegner, H. E. (MIT, Cambridge, MA). Jan 1973.

From International Conference on Inner Shell Ionization Phenomena and Future Applications; Atlanta, Georgia, United States of America (USA) (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

X-ray spectra have been measured which are produced as a result of collisions between 10- to 156-MeV chlorine, bromine, and iodine ions with targets of atomic numbers from 6 to 92. Energetic shifts of the x-ray lines have been determined with high accuracy. Systematic trends of these shifts have been found with respect to ion- and target species, ion velocities, and x-ray line species. A relativistic Dirac-Fock-Slater computer program has been used to relate the observed line shifts to possible electronic configurations of the radiating ions. (auth)

25674 (CONF-720404-(Vol.2), pp 1406-1419) PRODUCTION OF K X-RAYS BY IDENTICAL VELOCITY ^{2}H, ^{4}He, ^{12}C, AND ^{16}O PROJECTILES. Lewis, C. W.; Watson, R. L.; Natowitz, J. B.; Hardt, T. L. (Texas A and M Univ., College Station). Jan 1973.

From International Conference on Inner Shell Ionization Phenomena and Future Applications; Atlanta, Georgia, United States of America (USA) (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

Measurements directed at comparing the yields of K x-rays produced by equal velocity alpha particles and deuterons incident on targets of Cl, Ca, Ti, Cu, and Ni have been carried out over an energy range of 2.9 to 20 MeV/amu. Significant deviations from the x-ray yield ratios expected on the basis of the plane-wave Born-approximation theory have been observed. The x-ray yield ratios display a crossover behavior in which the measured ratio is smaller than expected at low projectile velocities, rises above the expected value at higher velocities, and finally decreases toward the expected value at the highest velocities. In addition measurements have been performed in which the yields of Cu K x-rays produced by 6.07 MeV/amu $^{4}He^{+2}$, $^{12}C^{+6}$, and $^{16}O^{+8}$ were compared. The observed x-ray yield ratio deviations were found to increase monotonically with increasing projectile atomic number. (auth)

25675 (CONF-720404-(Vol.2), pp 1420-1438) K AND L X RAYS OF Ag AND THE L X RAYS OF Au PRODUCED BY 12- TO-50 MeV ^{16}O BEAMS. Nettles, P. H. (Univ. of North Carolina, Chapel Hill); Bissinger, G. A.; Shafroth, S. M.; Waltner, A. W. Jan 1973.

From International conference on inner shell ionization phenomena and future applications; Atlanta, Georgia, USA (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

The K and L x rays of Ag and the L x rays of Au produced by ^{16}O beams on thin targets were studied with two Si(Li) detectors, of 200- and 540-eV resolution for a 6-keV x-ray line. Absolute shell-ionization cross sections were derived from the measured x-ray yields and compared to PWBA predictions, which were corrected (for the K shell only) for Coulomb-repulsion and binding-energy effects. The agreement between theory and experiment was not good in general, although the observed energy dependences of σ_K for Ag and σ_L for Au were in agreement with theory. The energies of the Kα and Kβ lines of Ag and the Lα, Lβ, and Lγ lines of Au were observed to vary with ^{16}O energy, with smaller shifts at the lower beam energies. The beam-energy dependence was measured for each of the intensity ratios Kα/Kβ and (Kβ_1 + Kβ_3)/Kβ_2 for Ag, and Lα/Lβ and Lα/Lγ for Au. These ratios showed stronger variations at the lower bombarding energies. (auth)

25676 (CONF-720404-(Vol.2), pp 1439-1449) X-RAY PRODUCTION BY NEON AND HELIUM ION BEAMS. McKnight, R. H.; Thornton, S. T.; Ritter, R. C. (Univ. of Virginia, Charlottesville). Jan 1973.

From International Conference on Inner Shell Ionization Phenomena and Future Applications; Atlanta, Georgia, United States of America (USA) (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

Characteristic x-rays have been produced by bombarding thick targets of Ni, Mo, Ag, Sm, and Ta with helium and neon beams of energies 1.5 to 5 MeV. The x-rays were detected with a cooled Si(Li) detector. Yields were measured for the K shell ionization of Ni, Mo, and Ag and for the L shell ionization of Sm and Ta. Ionization cross sections reduced from the thick target yields are presented for each of the bombarding ions and comparisons with the Born approximation predictions are made where applicable. The use of heavy ions as bombarding particles for trace element analysis is discussed in light of the present measurements. (auth)

25677 (CONF-720404-(Vol.2), pp 1450-1463) X-RAY PRODUCTION FROM HIGH-ENERGY, HEAVY-ION INTERACTIONS. Jundt, F. C.; Kubo, H.; Purser, K. H. (Univ. of Rochester, NY). Jan 1973.

From International Conference on Inner Shell Ionization Phenomena and Future Applications; Atlanta, Georgia, United States of America (USA) (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

Cross sections for the production of K, L, and some M x-rays have been measured using Br, I, and Bi as projectiles on Fe, Ni, Ge, As, Y, Ag, Sb, Ta, W, and Pb targets. These measurements were made between 25 and 120 MeV by means of direct comparison with Rutherford scattering using a Si(Li) detector. Absolute x-ray production cross sections as high as 300,000 barns were observed with a strong dependence of the equality of matching energy levels. In some measurements the experimental K_α/K_β ratio is much higher than those values measured by electron or proton excitation. This change in ratio reflects multiple electron vacancies. (auth)

25678 (CONF-720404-(Vol.2), pp 1473-1483) CAPTURE OF INNER SHELL ELECTRONS BY FAST PROTONS. Presnyakov, L. P. (Lebedev Physical Inst., Moscow). Jan 1973.

From International conference on inner shell ionization phenomena and future applications; Atlanta, Georgia, USA (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

Charge exchange between protons and many-electron atoms is considered. It is shown that at sufficiently high collision energies the capture of an optical electron becomes ineffective, and the principal role is assumed by charge exchange on the inner shells of the target atom. The results of the calculations are in agreement with the experimental data. A possibility of producing inverted population in atomic beams by charge exchange of protons with alkali-element atoms is discussed. (auth)

25679 (CONF-720404-(Vol.3)) PROCEEDINGS OF THE INTERNATIONAL CONFERENCE ON INNER SHELL IONIZATION PHENOMENA AND FUTURE APPLICATIONS, APRIL 17-22, 1972. Fink, R. W.; Manson, S. T.; Palms, J. M.; Rao, P. V. (eds.) (Georgia Inst. of Tech., Atlanta; Emory Univ., Atlanta, GA). Jan 1973. 745p. (In English and French). Dep. NTIS.

From International Conference on Inner Shell Ionization Phenomena and Future Applications; Atlanta, Georgia, United States of America (USA) (17 Apr 1972).

The conference included 41 papers one of which was abstracted previously in NSA as 26: 41692. Separate abstracts were prepared for 39 papers. One paper was outside the scope of NSA. (JFP)

For abstracts of individual papers see: 25623, 25635, 25680–25691, 26070, 26091, 26092, 26126, 26144, 26145, 26181–26188, 26235–26238, 26319–26321, and 26366–26369.

25680 (CONF-720404-(Vol.3), pp 1485-1508) MECHANISMS OF INNER SHELL EXCITATION AND DEEXCITATION IN MULTIPLY IONIZED ATOMS. Rudd, M. E. (Univ. of Nebraska, Lincoln). Jan 1973.

From International Conference on Inner Shell Ionization Phenomena and Future Applications; Atlanta, Georgia, USA (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

An energy level diagram is presented in which inner-shell and

combinations of inner- and outer-shell vacancy states are displayed with different degrees of ionization separated into different columns. The Auger and x-ray spectra produced by photon, electron, proton, and heavy ion impact are compared. Several mechanisms of inner-shell excitation are examined; especially the electron promotion mechanisms of Fano and Lichten, and the methods by which it has been used to determine the energy dependence of excitation by heavy ions. The basic deexcitation mechanisms, x-ray and Auger emission, and combinations of these are considered. The need to define a fluorescence yield for each excited state is pointed out. (auth)

25681 (CONF-720404-(Vol.3), pp 1509-1542) THEORY OF MULTIPLE IONIZATION PROCESSES. Aberg, T. (Helsinki Univ. of Tech., Otaniemi, Finland). Jan 1973.

From International conference on inner shell ionization phenomena and future applications; Atlanta, Georga, USA (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

The current understanding of multiple ionization by photon and electron impact is summarized with particular regard to double ionization of two-electron systems and to outer-shell excitation and ionization following K-shell ionization. A discussion is given of various approximate double ionization and simultaneous excitation and ionization relative cross sections in comparison with experimental data. An effort is made to unravel various mechanisms responsible for multiple ionization. (auth)

25682 (CONF-720404-(Vol.3), pp 1543-1571) THEORY OF MULTIPLE IONIZATION PROCESSES. Larkins, F. P. (Monash Univ., Clayton, Australia). Jan 1973.

From International conference on inner shell ionization phenomena and future applications; Atlanta, Georgia, USA (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

Recent developments in the theory of inner-shell ionization phenomena relating to electronic excitations produced by heavy-ion bombardment of solid and gaseous targets are discussed. Correlation diagrams for the symmetric Ne–Ne and the asymmetric Ne–Ar and Al^+–Ar systems determined by ab initio Hartree–Fock molecular orbital method are presented and used to critically appraise the electron-promotion mechanism based on the quasi-molecular model. Possible extensions to the simplest model to explain some of the experimental results for asymmetric systems that are not in agreement with its predictions are considered. Other experimental findings are interpreted as indicating that direct excitation processes associated with the molecular complex are also important. The suitability of theoretical methods so far employed for the identification of the defect configurations responsible for the satellite structure observed by high resolution spectroscopic techniques are discussed. Particular reference is made to recent work on aluminum metal. Evidence is presented to show that solid state effects may complicate the correct identification of the parent multiple vacancy configurations. (auth)

25683 (CONF-720404-(Vol.3), pp 1572-1585) THEORETICAL FLUORESCENCE YIELDS FOR MULTIPLY IONIZED ARGON. Bhalla, C. P.; Walters, D. L. (Kansas State Univ., Manhattan). Jan 1973.

From International conference on inner shell ionization phenomena and future applications; Atlanta, Georgia, USA (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

The cross section of inner shell vacancy production in an ion–atom collision can be obtained by the ratio of the experimental σ_x and the theoretical fluorescence yield, ω, for the particular shell. The theoretical values of ω depend upon the charge state of the atom before de-excitation. Numerical results are presented for the K-shell and the 2p-shell for argon as function of the number 3p electrons. The value ω_{2p} depends critically on the occupancy in the 3p shell. The effects of the inclusion of the 3d excited state on ω_{2p} are also presented. (auth)

25684 (CONF-720404-(Vol.3), pp 1586-1616) CREATION OF MULTIPLE VACANCIES. Krause, M. O. (Oak Ridge National Lab., TN). Jan 1973.

From International conference on inner shell ionization phenomena and future applications; Atlanta, Georgia, USA (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

Experimental evidence and consequences of the creation of multiple vacancies by photons and electrons are summarized. Representative data are given of observations of ion charges, x-ray Auger satellites, and photo-electron spectra. Characteristics and systematics of double vacancies in KL shells are treated in detail, and double ionization in other inner shells is discussed in broader terms. Double ionization, and simultaneous excitation and ionization, in the outermost shells of free atoms, are also included as they offer information on energy dependence and selection rules of two-electron transitions. Emphasis is placed on the relation between multiple vacancies and x-ray or Auger satellites which are often used as observables. (auth)

25685 (CONF-720404-(Vol.3), pp 1617-1640) MULTIPLE IONIZATION FROM COLLISION PROCESSES. Quarles, C. A. (Texas Christian Univ., Fort Worth). Jan 1973.

From International conference on inner shell ionization phenomena and future applications; Atlanta, Georgia, USA (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

Some of the more recent experimental work on the production of multiply charged states of atoms and ions produced primarily by electron bombardment is reviewed. Some comparisons, however, will be made with results obtained from photo-ionization experiments. Both the results of measurements of relative abundances of multiply charged states and of various coincidence experiments will be discussed. (auth)

25686 (CONF-720404-(Vol.3), pp 1641-1665) X-RAY PRODUCTION BY HEAVY IONS. Richard, P. (Univ. of Texas, Austin). Jan 1973.

From International conference on inner shell ionization phenomena and future applications; Atlanta, Georgia, USA (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

The atomic interactions from proton plus target (p + T) and oxygen plus target (O + T) collisions at MeV incident energies will be discussed. For the reactions studied much information can be learned about the final ion T^{+n} and about the reaction mechanism by observation of the x-ray emission spectra and the Auger electron spectra. The observed target K and L x-ray spectra for a wide range of incident energy and target Z will be discussed as well as the average inner shell ionizations deduced from the data. High resolution data obtained with a crystal spectrometer in which specific ionization states can be resolved will also be presented for a few specific atoms. For Mg, Al, and Si $1s \rightarrow 2p$ transitions from initial configurations $(1s)^{-1}(2p)^{-n}$ for $n = 0, 1, 2, 3, 4$, and 5 are clearly resolved. Calculations of the expected Auger electron spectra will also be presented. (auth)

25687 (CONF-720404-(Vol.3), pp 1667-1672) DOUBLE AND TRIPLE IONIZATION IN ALUMINUM, GALLIUM, AND SCANDIUM BY ELECTRON IMPACT. Abouaf, R. (Paris Univ., Orsay, France). Jan 1973.

From International conference on inner shell ionization phenomena and future applications; Atlanta, Georgia, USA (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

The structures appearing on ionization efficiency curves charged atomic ions are generally caused by Auger processes following inner shell ionization. Supplementary electron ejections are sometimes invoked, in order to explain the experimental observations. Some results on aluminum, gallium and scandium in vapor phase are presented, which show evidence of ion formation by Auger processes, and in the cases of Al^{3+} and Ga^{3+}, evidence of the double Auger process. Atomic vapors are generated in a Knudsen cell. Ion production is achieved in a Nier-type ion source by electron impact up to 2000 eV, and the ions are analyzed by a 60° sector deflection mass spectrometer. Finally, ionization efficiency (I.E) curves are obtained ($I^+ = f(E)$) for each type of multicharged ion observed. (auth)

25688 (CONF-720404-(Vol.3), pp 1675-1681) MULTIPLE INNER SHELL VACANCY PRODUCTION BY LIGHT ION BOMBARDMENT. Knudson, A. R.; Burkhalter, P. G.; Nagel, D. J. (Naval Research Lab., Washington, DC). Jan 1973.

From International conference on inner shell ionization phenomena and future applications; Atlanta, Georgia, USA (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

Aluminum Kα x-ray spectra excited by protons and helium ions indicate that simultaneous K- and L-shell vacancies are produced with a probability, relative to single K-shell vacancy production, which is substantially in excess of the shake off value. This probability decreases toward the shake off value with in-

creasing ion energy. For 1.5 MeV ^{4}He ions incident on aluminum, the ratio of K + L intensity to K intensity is 2.2, which is 22 times the ratio measured for photon and electron excitation. Simultaneous direct Coulomb excitation of both K- and L-shell electrons appears to be taking place. (auth)

25689 (CONF-720404-(Vol.3), pp 1682-1695) MULTIPLE INNER-SHELL IONIZATION EFFECTS IN X-RAY EMISSION INDUCED BY ALPHA PARTICLES AND CARBON IONS. Hansen, J. S.; Li, T. K.; Watson, R. L. (Texas Agricultural and Mechanical Univ., College Station). Jan 1973.

From International conference on inner shell ionization phenomena and future applications; Atlanta, Georgia, USA (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

A detailed examination of K_β to K_α x-ray intensity ratios has been carried out for a wide range of elements using 2.3 to 7.5 MeV/amu alpha particles and deuterons. Large differences were observed between the results obtained for alpha particles and those obtained for deuterons of the same velocity with elements below approximately Z = 28. Further measurements directed at comparing the characteristics of K_β x-rays produced by equal velocity alpha particles and carbon ions revealed K_β x-ray energy shifts and intensity variations which depended on target thickness. These effects were all found to be attributable to simultaneous K- and L-shell vacancy production during the collision process. Estimates of the probabilities per K vacancy for simultaneous L-shell vacancy production in Ti and Fe by 3.3 MeV/amu alpha particles are given. (auth)

25690 (CONF-720404-(Vol.3), pp 1748-1751) X-RAY EMISSION AND RADIATIVE LIFETIMES OF HIGHLY IONIZED NEON. Knystautas, E. J.; Barrette, L.; Beauchemin, G.; Drouin, R. (Univ. of Laval, Quebec). Jan 1973.

From International conference on inner shell ionization phenomena and future applications; Atlanta, Georgia, USA (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

Emission spectra of highly ionized neon have been obtained using the beam-foil technique at 9 MeV. Some two hundred emission lines, including new ones, have been observed in the region of 25 to 250 eV (50 to 500 Å) using a grazing-incidence spectrometer whose resolution in this region is about 0.3 eV. The lines have been assigned to know excited levels of Ne^{6+} to Ne^{8+}, and the radiative lifetimes of several of these levels have been measured. (auth)

25691 (CONF-720404-(Vol.3), pp 1752-1758) X-RAY EMISSION FROM METASTABLE STATES PRODUCED IN FOIL EXCITATION OF A FAST CHLORINE BEAM. Cocke, C. L.; Macdonald, J. R.; Curnutte, B. (Kansas State Univ., Manhattan). Jan 1973.

From International conference on inner shell ionization phenomena and future applications; Atlanta, Georgia, USA (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

X-rays from metastable states produced by the passage of chlorine beams of 20 to 55 MeV through thin carbon foils have been observed in a Si(Li) detector. The spatial decay curves of the chlorine K_α-x ray yield are complex but indicate major contributions from at least two metastable states with lifetimes in the vicinity of 1.3 and 10 ns. The much weaker K_β line shows evidence for decay from a state whose lifetime is near 1 ns. The K_α and K_β x-rays observed downstream are shifted to higher energies (relative to x-rays from singly ionized chlorine) by amounts consistent with their emission by a highly ionized chlorine system. X-ray yields per incident ion from these metastable states have been measured as a function of energy and will be presented. (auth)

25692 (EUR-4938, pp 279-283) INTERACTION OF HIGH ENERGY HYDROGEN IONS WITH HYDROGEN CLUSTERS. Falter, H. D.; Henkes, P. R. W. (Institut fuer Kernverfahrenstechnik, Karlsruhe, Ger.). Dec 1972.

From seventh symposium on fusion technology; Grenoble, France (24 Oct 1972).

To gain information about the physical effects that govern the penetration of DT clusters into a thermonuclear plasma, the influence of ion impact upon hydrogen clusters is studied. Depending on the ion energy clusters of $\approx 10^6$ atoms are ionized up to an average of ≈ 10 charges. No serious evaporation of neutral molecules occurs. (auth)

25693 (KFKI-72-68) RESONANCE PHENOMENA IN THE MULTIPHOTON IONIZATION OF EXCITED ATOMS. Bakos, J. (Magyar Tudomanyos Akademia Kozponti Fizikai Kutato Intezete, Budapest). Dec 1972. 23p. Dep. NTIS (U. S. Sales Only) $3.25.

The experimentally measured power, k, in the power function dependence of the multiphoton ionization probability $W \sim \alpha I^k$ has been found in this institute laboratory to be higher than the theoretical value of the number of photons, k_0, absorbed in the ionization process, contrary to the result $k < k_0$ of previous measurements. The variation of the power in different experimental circumstances is explained by multiphoton resonances with the atomic levels. The general dependence of the multiphoton ionization probability on the light intensity, measured over a wide range, deviates strongly from the power law dependence and can be used to determine the Stark shift of the atomic states involved. (auth)

25694 (UCRL-51326) THEORETICAL PHOTOIONIZATION CROSS SECTIONS FROM 1 TO 1500 keV. Scofield, J. H. (California Univ., Livermore. Lawrence Livermore Lab.). 12 Jan 1973. Contract W-7405-Eng-48. 376p. Dep. NTIS $3.00.

Cross sections for photoionization from elements with Z from 1 to 101 and for photon energies from 1 to 1500 keV were calculated. In this calculation, the electrons are treated relativistically and as moving in a Hartree–Slater central potential. Cross sections for ionizations from the individual subshells are given. (auth)

25695 DOUBLE CHARGE TRANSFER SPECTROSCOPY OF DIATOMIC MOLECULES. Appell, J.; Durup, J.; Fehsenfeld, F. C.; Fournier, P. (Paris Univ., Orsay, France). J. Phys., B (London); 6: No. 1, 197-205(Jan 1973).

Translational energy spectra of H^- ions arising from single- and double-collision double charge transfer of 4 keV protons on N_2, O_2 and NO have been measured. The energy values of some doubly ionized states of these molecules were determined. The spin conservation rule is shown to hold strictly for these processes. Approximate selection rules bearing on the symmetry of the involved states are proposed and used for the discussion of the results. (auth)

25696 PURE MULTI-PHOTON IONIZATION OF THE GROUND 1S AND METASTABLE 2S STATE OF THE HYDROGEN ATOM WITH PLANE-POLARIZED LIGHT OF THRESHOLD FREQUENCY. Parzynski, R. (Michiewicz Univ., Poznan, Poland). Phys. Lett.; 43A: No. 2, 171-172(26 Feb 1973).

Formulas for N-photon ionization of the hydrogen atom states 1S and 2S with plane-polarized light at the threshold frequency $\omega = I/N\hbar$ (I ionization energy) are proposed and shown to reduce in the one-photon case to the well known Stobbe expressions. (auth)

25697 X-RAYS FROM ION–ATOM COLLISIONS IN SOLID TARGETS. Der, R. C.; Fortner, R. J.; Kavanagh, T. M. (Univ. of California, Livermore). Phys., Lett.; 43A: No. 2, 153-154 (26 Feb 1973).

X-ray spectra from 100-keV Ne^+ bombardment of solid copper targets are presented. Copper L x-rays are more intense than neon K x-rays, in disagreement with simple systematics for diabatic molecular orbitals. The data can be explained by the increase of the neon 1s binding energy caused by outer-shell stripping. (auth)

25698 PHASE SHIFTS OF POSITRONS SCATTERED ELASTICALLY BY HELIUM ATOMS. Moussa, A. H.; Abdel-Radi, H. M. (Ain Shams Univ., Cairo). Physica; 63: No. 1, 197-208 (1 Jan 1973).

The Kohn variational method with a multi-parameter trial wave function has been applied to the low-energy s-wave elastic scattering of positrons by helium atoms. The phase shifts obtained are in qualitative agreement with those obtained by other authors applying different methods. Quantitatively, the size of the phase shifts indicates that the chosen trial wave function allows for the effect of polarization of the atom. (auth)

25699 DETERMINATION OF SIGNS OF ATOMIC SPLITTING CONSTANTS USING LEVEL-CROSSING TECHNIQUES. von Oppen, G.; Popp, H. W. (Technische Univ., Berlin). Physica; 63: No. 1, 104-112(1 Jan 1973).

By measuring the positions of level-crossing signals the ratio of atomic splitting constants (hfs constants, g_J values, tensor polarizabilities, etc.) can be investigated. However, due to the time-reversal properties of the atomic Hamiltonian these measurements often yield no information about the sign of these constants. Nevertheless, the sign of tensor polarizabilities and other splitting constants can be determined by use of circularly polarized light if the shape of $\Delta\mu = I$ crossing signals is studied. A convenient experimental setup is proposed and applied to the measurement of the

sign of the tensor polarizability $\alpha_{ten}(^1P_1)$ of the first excited $^1P_1$ level of the Sr-I spectrum, where a negative sign was found. (auth)

25700 SHAPE AND AMPLITUDE OF LEVEL-CROSSING SIGNALS. von Oppen, G. (Technische Univ., Berlin). Physica; 63: No. 1, 95-103(1 Jan 1973).

In view of measurements of signs of atomic splitting constants we rediscuss shape and amplitude of level-crossing signals with special regard to $\Delta\mu = 1$ crossings. Simple relations between the geometry of the experimental setup and the shape of level-crossing signals are derived in this study. Whether the scattered-light intensity increases or decreases at a crossing depends, under special conditions, on the state vectors of the crossing sublevels. Therefore, through the sign of such signals one obtains additional information valuable in connection with the determination of signs of atomic splitting constants. Further, some relations between the eigenstates of crossing sublevels are derived. These relations yield some new prospects for the detectability of $\Delta\mu = 1$ crossings. (auth)

25701 ELECTRON SCATTERING FROM SIMPLE ATOMIC AND MOLECULAR SYSTEMS: A STUDY OF THE PHENOMENOLOGICAL AND MICROSCOPIC OPTICAL MODELS. Alton, G. D. Knoxville, TN; Univ. of Tennessee (1972). 135p. University Microfilms Order No. 73-2415.

THESIS (PH. D.).

Optical potential methods of analysis are used to study low energy electron scattering from simple atoms and molecules. In order to specify the optical potential which is used to describe the collisional phenomena in question it is possible to take either a semi-empirical or a theoretical approach. Both of these approaches are used in this study. In the studies made with the phenomenological optical model, an attempt is made to obtain physically reasonable potential functions which will reproduce certain experimentally observed electron-hydrogen, electron-helium scattering data. Local complex potentials, characterized by energy dependent parameters, are used to generate elastic and inelastic scattering cross sections which are compared with experimental measurements for the processes studied. The microscopic optical model offers a means of introducing more realistically the dynamical effects of all open and closed channels than many other analytical methods. The microscopic optical model is used in determining the total contributions to the elastic and inelastic scattering cross sections from all open channels for electron-atomic hydrogen interactions. Mathematically tractable elastic channel equations are derived for electron scattering from hydrogen and diatomic molecules by approximating the intermediate state coupling through a free-particle Green's function. The numerical procedure used to obtain the solution to these equations and to generate the elastic and inelastic scattering from hydrogen is discussed. The results are compared with available experimental measurements. (Diss. Abstr. Int., B)

25702 ELECTRON CAPTURE IN ION–ATOM COLLISIONS AT INTERMEDIATE ENERGIES. Winter, T. G. Madison, WI; University Microfilms Order No. 72-29,518 (1972). 259p. University of Wisconsin.

THESIS (PH. D.).

Cross sections for the processes of electron capture $H^+ + H(1s) \rightarrow H(nl) + H^+$, $H^+ + He(1s^2) \rightarrow H(nl) + He^+(1s')$, and $He^+(1s') + He(1s^2) \rightarrow He(N^1,^3L) + He^+(1s')$ are theoretically determined for various excited states at impact velocities of the order of, or greater than, mean atomic velocities. (JFP)

25703 ELECTRON IMPACT EXCITATION AND COLLISIONAL PERTURBATION STUDIES IN HYDROGEN. Mickish, R. A. Norman, OK; Univ. of Oklahoma (1972). 133p. University Microfilms Order No. 73-4951.

THESIS (PH. D.).

High vacuum static and flow systems for the study of electron impact excitation cross sections have been developed at the University of Oklahoma by R. M. St. John and his graduate students. These systems were modified to some extent and used to obtain electron impact excitation of the hydrogen atom by electron-molecule collisions and electron-atom collisions. Hydrogen Balmer optical excitation functions were monitored in these studies. In addition work was initiated for the purpose of conducting the difficult experiments necessary to evaluate the measured optical excitation functions. We discuss the results of these experiments in detail. We conclude that collisional perturbations are a significant feature under some experimental conditions. Finally, a lifetime measuring system, or time resolution system capable of extending the information gathering capabilities of the cross section system is discussed and presented. (Diss. Abstr. Int., B)

25704 MEASUREMENT OF EQUILIBRIUM CHARGE DISTRIBUTION WITH A THICK TARGET. Fukuzawa, F. (Kyoto Univ.). Phys. Lett., 43A: No. 2, 147-148(26 Feb 1973).

Combinations of a position sensitive detector and an electric or a magnetic field are shown to be suitable for measurement of the equilibrium charge distributions of the scattered ions from a thick target. (auth)

25705 POLARIZATION OF THE 492.2 NM LINE OF HELIUM (EXCITED BY ELECTRONS) AT ENERGIES NEAR 60 eV. Heideman, H. G. M.; Van Ittersum, T. (Univ., Utrecht). Physica; 63: No. 2, 368-372(15 Jan 1973).

The polarization of the 492.2 nm ($4^1D \rightarrow 2^1P$) line of helium, excited by electrons, has been measured as a function of the incident electron energy in the energy range from 56 to 62 eV. In this energy region prominent resonances occur in the optical excitation functions of various helium states. The polarization measurements show that these resonances have little or no effect at all on the polarization of the 492.2 nm line. (auth)

25706 X-RAY EMISSION CROSS SECTIONS AND FLUORESCENCE YIELDS FOR LIGHT ATOMS AND MOLECULES BY ELECTRON IMPACT. Tawara, H.; Harrison, K. G.; De Heer, F. J. (FOM-Instituut voor Atoom- en Molecuulfysica, Amsterdam). Physica; 63: No. 2, 351-367(15 Jan 1973).

The cross sections for K-shell x-ray emission have been measured for 0.2 to 18 keV electrons incident on CH_4, N_2, O_2, Ne and Ar. The measurements are compared with available K-shell Auger-electron ejection cross sections (between 0.5 and 11 keV) in order to deduce the fluorescence yields (ω_K) for these shells. It is found that there is no dependence of ω_K on the incident electron energy, and the experimental values are in good agreement with recent theoretical calculations of Walters and Bhalla. The influence of simultaneous inner- and outer-shell ionization, shake-off effects and the molecular environment on the fluorescence yields is discussed. (auth)

25707 CALCULATION OF ANISOTROPIC GLORIES FOR ATOM-MOLECULE COLLISIONS. Franssen, W.; Reuss, J. (Catholic Univ., Nijmegen, Netherlands). Physica; 63: No. 2, 313-320(15 Jan 1973).

A very simple expression is derived which allows us to discuss the glory structure in the anisotropic part of the total collision cross section, obtained from state-selected molecules with different orientations. Some numerical results are presented. (auth)

25708 RADIATION FROM ATOMS CAUSED BY FAST CHARGED PARTICLES. Muzylev, E. L. (Moscow State Univ.). Izv. Akad. Nauk Arm. SSR, Ser. Fiz.; 7: No. 1, 11-17(1972). (In Russian).

The effects of the displacement of spectral lines from forced transitions, induced by fast charged particle, are estimated. The dependences of these displacements on particle speed are revealed; the probabilities of given transitions are found. (auth)

25709 MEASUREMENT OF THE DIFFERENTIAL SCATTERING CROSS SECTIONS OF K ON Ar, N_2, CH_4, CF_2Cl_2, CH_3F, AND CF_4 WITH CROSSED SUPERSONIC MOLECULAR BEAMS. Hose, H.; Koller, U.; Schuegerl, K. (Technische Univ., Brunswick). Z. Phys. Chem. (Frankfurt); 82: No. 1-4, 97-108(Nov 1972). (In German).

The large angle scatterings of K on Ar, N_2, CH_4, CF_2Cl_2, CH_3F, and CF_4 were measured by crossing of a potassium atomic beam, which was formed from a K–He supersonic free jet, with the corresponding supersonic molecular beam. By transform of the distributions from laboratory to center of mass system the differential cross sections were evaluated and from the rainbow angle the parameter ϵ of the Lennard-Jones(6,12)-potential for different scattering partners was calculated. (auth)

Atomic Theory

Refer also to abstracts 24327, 25942, 25955, 26402, and 26403.

25710 (AD-749490) ATOMIC PHYSICS, OPTICAL COHERENCE AND SCATTERING AND HIGH ENERGY PHENOMENA. Final Report, 1 July 1970–29 February 1972. Barut, A. O. (Colorado Univ., Boulder. Dept. of Physics). 28 Mar 1972. 13p. (AFOSR-TR-72-1926). NTIS.

The report briefly summarizes research in domain of atomic physics, electromagnetic scattering theory, atomic models for hadrons, conformal invariance of physical laws and related mathematical problems. Specific accomplishments include the dis-

covery of the quantum mechanical superposition of two states with positive and negative values of magnetic charge, the development of a new theory of a conformally invariant dimensionless mass for massive particles and the formulations of the electromagnetic scattering problem of the group space SU (A). A list of publications which resulted from this effort is also included. (auth) (NTIS)

25711 (CONF-720404-(Vol.1), pp 9-42) AUGER AND RADIATIVE TRANSITION PROBABILITIES. Crasemann, B. (Univ. of Oregon, Eugene). Jan 1973.

From International Conference on Inner Shell Ionization Phenomena and Future Applications; Atlanta, Georgia, United States of America (USA) (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

Calculations of radiationless and x-ray transition rates and of atomic level widths are reviewed, and results are compared with experimental information. Areas are identified in which there is need for new experiments, and extensions of theoretical work are suggested. (auth)

25712 (CONF-720404-(Vol.1), pp 80-115) K-SHELL FLUORESCENCE YIELDS. Bambynek, W. (EURATOM, Gell, Belgium). Jan 1973.

From International conference on inner shell ionization phenomena and future applications; Atlanta, Georgia, USA (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

A review is given of our knowledge on K-shell fluorescence yields. The most important experimental methods of measurements are summarized and discussed. A set of most reliable ω_K values is evaluated and compared with recent theoretical predictions. (auth)

25713 (CONF-720404-(Vol.1), pp 285-316) RELATIVE X-RAY EMISSION RATES. Salem, S. I. (California State Univ., Long Beach). Jan 1973.

From International conference on inner shell ionization phenomena and future applications; Atlanta, Georgia, USA (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

This is a presentation of the current status of the relative transition ratios: $K\alpha_2/K\alpha_1$, $K\beta_3/K\beta_1$, $K\beta/K\alpha$, $K\beta_2'/K\alpha_1$, $L\beta_4/L\beta_3$, $L\gamma_2/L\beta_3$, $L\gamma_3/L\beta_3$, $L\eta/L\beta_1$, $L\gamma_1/L\beta_1$, $L\beta_{2,15}/L\alpha_1$, $L\alpha_2/L\alpha_1$, $L\beta_5/L\alpha_1$, $L\beta_6/L\alpha_1$, and $Ll/L\alpha_1$. Theoretical calculations based on relativistic Hartree-Fock-Slater (RHFS) potential and those based on a screened relativistic coulomb (SRC) potential are reviewed, and their results compared. The experimental data accumulated in the past few years is graphically presented with the theoretical results. (auth)

25714 (CONF-720404-(Vol.1), pp 475-489) MANY BODY PERTURBATION THEORY APPLIED TO ATOMIC RADIATIONLESS TRANSITIONS. Holmes, C. P.; Kostroun, V. O. (Cornell Univ., Ithaca, NY). Jan 1973.

From International conference on inner shell ionization phenomena and future applications; Atlanta, Georgia, USA (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

The many body perturbation theory of Brueckner and Goldstone has been applied to atomic radiationless (Auger and Coster-Kronig) transitions. Starting with the N electron atomic Hamiltonian and determinental states describing the inner shell vacancies, expressions for the transition probabilities are derived for both single and double Auger transitions. The expressions are in the form of linked-cluster perturbation expansions. The lowest order contribution to the single Auger transition rate is identical to the ansatz of Wentzel which has been applied successfully in many calculations. The lowest order expressions for the double Auger transition rate and the corresponding diagrams are presented. (auth)

25715 (CONF-720404-(Vol.1), pp 792-804) ELECTRONIC SCREENING IN INNER SHELLS. Mande, C. (Nagpur Univ., India); Tankhiwale, A. V.; Khare, P. L. Jan 1973.

From International conference on inner shell ionization phenomena and future applications; Atlanta, Georgia, USA (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

The effect of the inter-electron interaction on orbital energies in an atom has been expressed by Sommerfeld by means of two screening parameters σ_1 and σ_2. For hydrogen-like wave functions and their energy eigenvalues, this interaction can be expressed in terms of the effective Z values Z_f and Z_p respectively. A procedure to calculate Z_f values from the Z_p values obtained by Mande and Damle is described here. The correlation between $Z-Z_f$ and $Z-Z_p$ values and the screening constants σ_1 and σ_2 is discussed. (auth)

25716 (CONF-720404-(Vol.2), pp 807-815) INNER SHELL IONIZATION AS A SINGLE ELECTRON PROCESS. Cooper, J. W. (National Bureau of Standards, Washington, DC). Jan 1973.

From International conference on inner shell ionization phenomena and future applications; Atlanta, Georgia, USA (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

Excitation or ionization of inner shell electrons by photons, protons, electrons or heavy charged particles can be viewed within a common theoretical framework provided the interaction of the incident particle with the system being bombarded is sufficiently weak. Within this approximation, the ionization process depends only on the energy and momentum transferred to the ionized system and may be characterized by a "Bethe Surface" in these variables. Quantitative calculations of specific processes and interpretation of experimental data often consider ionization as a single electron (two-body) process. The basic theory of inner shell ionization treated as a single electron process will be reviewed briefly with emphasis on its range of validity and the relation between information obtained via excitation by different incident particles. (auth)

25717 (CONF-720404(Vol.4), pp 2305-2330) FUTURE APPLICATIONS OF PHOTOELECTRON SPECTROSCOPY. Albridge, R. G. (Vanderbilt Univ., Nashville). Jan 1973.

From International conference on inner shell ionization phenomena and future applications; Atlanta, Georgia (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

A survey of the theory of inner shell ionization from photoelectron spectroscopy studies. The future direction of research is also briefly mentioned. (JFP)

25718 (CONF-720470-1) MAGNETIC-DIPOLE HYPERFINE MATRIX ELEMENTS FOR MOLECULAR CALCULATIONS VIA DIRAC THEORY. Lipas, P. O.; Pyykkoe, P.; Pajanne, E. (Helsinki Univ. (Finland). Research Inst. for Theoretical Physics). 1972. 28p. Dep. NTIS (U. S. Sales Only).

From Spring meeting of the British Radio Spectroscopy group: hyperfine interactions; Manchester, UK (5 Apr 1972).

The magnetic-dipole hyperfine matrix element is calculated from the Dirac theory for electronic wave functions centered at the origin and the nucleus arbitrarily located. The resulting single expression is compared in the nonrelativistic limit with the sum of the conventional orbital, spin-dipole, and contact terms. Also the matrix element of the A^2 term is given for two arbitrarily located nuclei. (auth)

25719 (IFVE-STF-71-10) ELECTROMAGNETIC CORRECTIONS FOR ATOMIC LEVELS. Sokolov, S. N.; Tikhonin, F. F.; Shchelkachev, A. V. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Serpukhov. Institut Fiziki Vysokikh Energii). 1971. 6p. (In Russian). INIS.

Some new calculations were made in connection with the Lamb shift of atomic levels which lead to good agreement of quantum electrodynamics with experiment. The contribution of Feynman diagrams to the Dirac form factor was evaluated by a hitherto unknown method. (tr-auth)

25720 (NP-19694) SECOND-ORDER MAGNETIC HYPERFINE INTERACTIONS IN ONE-ELECTRON ATOMS: CONNECTIONS BETWEEN THE SCHROEDINGER, DIRAC, AND QUANTUM ELECTRODYNAMICAL PERTURBATION CALCULATIONS. Latvamaa, E.; Kurittu, L.; Pyykkoe, P.; Tataru, L. (Helsinki Univ. (Finland). Research Inst. for Theoretical Physics). Aug 1972. 25p. Dep. NTIS (U. S. Sales Only) $3.25.

Second-order hyperfine interactions are considered for a one-electron atom, treating the nucleus as a point magnetic dipole of infinite mass and charge Z. The dominant contribution to the hyperfine splittings in the 1s and 2s states is found to arise from the ultra-relativistic continuum. In the high momentum limit the Schroedinger calculation gives a linear divergence while the Dirac and QED calculations give a logarithmic divergence. This explains why the nonrelativistic variational result of Gregson, Hall and Rees (1970) is too large by a factor of 10^2. The Dirac re-

sult is ¾ of the QED result, (¾) (α/π) $(\mu m/M)\ln(p_{max})$, because of a missing retardation term. The Schroedinger and Dirac residuals are in good agreement. (auth)

25721 STURMIAN EXPANSIONS OF THE RELATIVISTIC COULOMB GREEN FUNCTION. Manakov, N. L.; Rapoport, L. P.; Zapryagaev, S. A. (Voronezh State Univ., USSR). Phys. Lett., 43A: No. 2, 139-140(26 Feb 1973).

Sturmian expansion of the Coulomb Green function of the second- and first-order Dirac equations have been derived in both coordinate and momentum spaces. (auth)

PHYSICS (ELECTROFLUID AND MAGNETOFLUID)

25722 FLOW NEAR AN ACCELERATED PLATE IN THE PRESENCE OF A MAGNETIC FIELD. Mishra, Shankar Prasad; Mohapatra, Priti (Post-Graduate Department of Mathematics, Utkal University, Bhubaneswar, Orissa, India). J. Appl. Phys. 44: No. 3, 1194-1199 (Mar 1973).

Hydromagnetic flow of an incompressible viscous liquid due to the time-varying motion of an infinite flat plate is discussed in this paper. The magnetic field present is fixed relative to the plate. It is observed that as the magnetic field strength increases, the velocity at a point increases while the skin friction at the plate decreases at any instant. (auth)

25723 SECOND ORDER SOLUTIONS FOR STEADY MAGNETOHYDRODYNAMIC CHANNEL FLOW WITH ANISOTROPIC CONDUCTIVITY. Panton, D. M. (South Australian Inst. of Tech., Adelaide). Aust. J. Phys.; 25: No. 6, 719-733(Dec 1972).

Further investigation of steady magnetohydrodynamic flow through a straight channel of arbitrary cross section with nonconducting walls is considered, in the presence of anisotropic conductivity due to the Hall effect, where no restriction is made on the Reynolds number or magnetic Reynolds number. An approximate solution is provided by a perturbation expansion in terms of the Hall parameter, assumed small. Corrections are made to the first-order solutions established by Panton and Hosking (1971) and the solutions are then extended to the second order for a square channel. It is found that both the Reynolds number and magnetic Reynolds number terms have a significant influence on the mass transport, the former far outweighing the contribution to the flow established by Tani (1962) for the values of the flow parameters assumed. (auth)

25724 OSCILLATORY CONVECTION IN A VISCOELASTIC FLUID LAYER IN HYDROMAGNETICS. Bhatia, P. K. (Univ. of Jodhpur, India); Steiner, J. M. Aust. J. Phys.; 25: No. 6, 695-702(Dec 1972).

A study is made of the overstable mode of convection in an infinite horizontal layer of a viscoelastic fluid, heated from below, in the presence of a magnetic field. It is shown first that the problem is characterized by a variational principle. Proper solutions are then obtained for the case of two rigid boundaries using the variational method. It is found that the magnetic field has a stabilizing effect on the thermally induced overstability in a viscoelastic fluid, as in the case of an ordinary viscous fluid. The thermodynamic significance of the variational principle is also considered. (auth)

25725 MAGNETIC INHIBITION OF THERMAL CONVECTION. Van der Borght, R. (Monash Univ., Clayton, Australia); Murphy, J. O.; Spiegel, E. A. Aust. J. Phys.; 25: No. 6, 703-718(Dec 1972).

The effect of an imposed vertical magnetic field on convective transfer in a horizontal Boussinesq layer of fluid heated from below is studied in the mean field approximation. Solutions are found over a wide range of conditions, for free boundaries, by a combination of numerical and analytic techniques. Quantitative estimates are made of the significant modifications to the heat transfer which are brought about by the presence of the magnetic field. It is found that the general properties of nonlinear steady cellular convection seem to persist in the face of magnetic inhibition. (auth)

25726 EFFECTS OF THERMAL RADIATION IN MAGNETOHYDRODYNAMIC CHANNEL FLOW. Helliwell, J. B. (Univ. of Bradford, Eng.). J. Eng. Math.; 7: No. 1, 11-17(Jan 1973).

An exact solution is obtained for the Hartmann problem of the viscous laminar flow of an electrically conducting liquid between parallel walls in the presence of a transverse magnetic field when effects of thermal radiation are significant and thermal conductivity may be neglected. (auth)

25727 GEOMETRY OF MAGNETOHYDRODYNAMIC FLOW. Purushotham, G. (Government Nagarjunasagar Engineering Coll., Hyderabad, India). Def. Sci. J. (New Delhi); 22: 131-134 (Apr 1972).

An attempt was made to provide a description of the geometry of streamlines and fieldlines which is more direct than the representation given by Wasserman (1967). The new concepts are applied to the study of the kinematic properties of magnetohydrodynamic flow. It is found that the equation derived by Wasserman together with the characteristics of nonmagnetic flow can be deduced as a special case in the analysis. A kinetic energy potential is introduced which depends upon the geometry of the streamline only. The irrotational character of the electric field is expressed in an intrinsic form. (IAA)

25728 UNSTEADY MOTION OF A VISCOUS CONDUCTING LIQUID BETWEEN TWO POROUS CONCENTRIC CIRCULAR CYLINDERS ACTED ON BY A RADIAL MAGNETIC FIELD. Mahapatra, J. R. (R.B.C. Coll., Naihati, India). Appl. Sci. Res. (The Hague); 27: No. 4, 274-282(Feb 1973).

Some problems of a flow of conducting liquid through two porous nonconducting infinite circular cylinders rotating with various angular velocities for some time in the presence of a radial magnetic field were investigated. It is assumed that the rate of suction at the inner cylinder is equal to the rate of injection at the outer cylinder. Furthermore the induced electric and magnetic fields are neglected. (auth)

25729 ONE INVARIANT IN MAGNETOHYDRODYNAMICS ALLOWING FOR THE HALL EFFECT. Khantadze, A. G. (Inst. of Geophysics, Tbilisi, USSR). Izv. Akad. Nauk SSSR, Fiz. Atmos. Okeana; 8: No. 12, 1308-1309(Dec 1972). (In Russian).

A new Lagrange invariant was found for MHD in the form of a generalized "absolute" curl in dynamic meteorology. The starting point for this development was a system of MHD equations for an ideal, incompressible conducting liquid, making allowance for the Hall effect. (KSW)

PHYSICS (HIGH-ENERGY)

Particle Interactions and Properties (Experimental)

Refer also to abstract 25784.

25730 (LA-5153) PARTICLE PHYSICS AT LAMPF. Nieto, M. M. (Los Alamos Scientific Lab., N. Mex.). Jan 1973. Contract W-7405-eng-36. 20p. Dep. NTIS.

We will discuss the theoretical basis of the interest elementary particle physicists have in certain experiments that could be done at LAMPF. These experiments include strong interaction processes (πN elastic scattering to obtain the Σ-term and πN, $\pi\pi$, and NN scattering length measurements), electromagnetic interactions (measuring the π form factor and testing muon QED), weak processes (weak π decays, tests of lepton conservation, and neutrino scattering), as well as some polarization experiments. (auth)

25731 SEA LEVEL SEARCH FOR LEPTONIC QUARKS IN COSMIC RAYS. Hicks, R. B.; Flint, R. W.; Standil, S. (Univ. of Manitoba, Winnipeg). Nuovo Cim.; 14A: No. 1, 65-70(1 Mar 1973).

A search was made for relativistic leptonic quarks (charges e/3 and 2e/3) in the cosmic radiation near sea level using a narrow-angle scintillation counter telescope. The apparatus was oriented at large zenith angles (>75°) and thus used the atmosphere as an extended filter for hadronic quarks. A null result was obtained, leading to upper limits on such quark intensities of $\sim 1.7 \cdot 10^{-8}$ cm^{-2} sr^{-1} s^{-1} at the 90% confidence level. (auth)

Electromagnetic

25732 (COO-3069-116) INELASTIC ELECTRON–DEUTERON SCATTERING AND THE STRUCTURE OF THE NEUTRON. Technical Report. Bodek, A. (Massachusetts Inst. of Tech., Cambridge. Lab. for Nuclear Science). Dec 1972. Contract AT(11-1)-3069. 272p. (DSR-77907-E). Dep. NTIS $15.75.

Thesis.

Deep inelastic electron–proton and electron-deuteron cross sections have been measured at 18, 26, and 34° using the SLAC 8-GeV spectrometer facility. Incident electron energies ranged from 4.5 to 18.0 GeV. The square of the four momentum transfer ranged from $q^2 = 0.5$ (GeV/c) to a q^2 of 20 (GeV/c)^2. Emphasis was put on extraction of proton and neutron structure functions, and extraction of the neutron to proton cross section ratios. Studies were made of the deuteron nuclear binding effects on the scattering, and these effects were incorporated into the analysis. In combination with earlier results the data on the neutron–proton cross section ratio extends from a value of the scaling variable ω of 25 down to 1.17. The neutron cross sections were determined to be almost the same as the proton cross sections at high ω, but were found to decrease to about 38% of the proton cross section at an ω around 1.25. (auth)

25733 (DESY-72/70) ELECTROPRODUCTION OF $\pi^-\Delta^{++}$ (1236) AND OF $\pi^+\Delta^0$(1236) ON HYDROGEN. Dammann, I.; Driver, C.; Heinloth, K.; Hofmann, G.; Janata, F.; Karow, P.; Lueke, D.; Schmidt, D.; Specht, G. (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). Dec 1972. 47p. Dep. NTIS (U. S. Sales Only) $4.50.

The electroproduction of a π-meson and of a Δ(1236) nucleon resonance on hydrogen, $ep \rightarrow e\pi\Delta(1236)$, was investigated in the two charge states $\pi^-\Delta^{++}$ and $\pi^+\Delta^0$ by measuring the scattered lepton and the produced π-meson in coincidence. The differential cross sections as functions of W, q^2, $t-t_{min}$ and $\phi_{\pi q}$ were determined in the following kinematical region: $W = \sqrt{(\pi + \Delta)^2} = 2.0 - 3.0$ GeV, $|q^2| = |(e - e')^2| = 0.15 - 0.8$ GeV^2/c^2, $|t-t_{min}| = 0 - 0.5$ GeV^2/c^2 with $t = (p - \Delta)^2$, $\phi_{\pi q} = 0 - 360°$. (auth)

25734 (DESY-72/71) INCLUSIVE π^+ AND π^- DISTRIBUTIONS IN ELECTROPRODUCTION ON PROTONS. Dammann, I.; Driver, C.; Heinloth, K.; Hofmann, G.; Janata, F.; Karow, P.; Lueke, D.; Schmidt, D.; Specht, G. (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). Dec 1972. 54p. Dep. NTIS (U. S. Sales Only) $4.75.

We investigate the inclusive pion spectra in the electroproduction reaction $e\,p \rightarrow e\,\pi$ + anything in a coincidence experiment at DESY. Data are presented from the kinematical region $0.1 < |q^2| < 0.8$ GeV^2 and $3.15 < W < 2.8$ GeV as a function of the transverse momentum squared p_T^2, the Feynman variable x, and the azimuth angle ϕ. The charge ratio π^+/π^- is given in terms of the variables q^2 and x. The inclusive spectra are compared with results from photoproduction. (auth)

25735 (DESY-72/75) MEASUREMENT OF INCLUSIVE PHOTOPRODUCTION AT 3.2 GeV AND COMPARISON WITH ELECTROPRODUCTION. Burfeindt, H.; Buschhorn, G.; Genzel, H.; Heide, P.; Koetz, U.; Mess, K.-H.; Schmueser, P.; Sonne, B.; Vogel, G.; Wiik, B. H. (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). Dec 1972. 16p. Dep. NTIS (U. S. Sales Only) $3.00.

Inclusive photoproduction cross sections for pions, kaons and protons have been measured in the photon fragmentation region and are compared with recent electroproduction data at $q^2 = 1.16$ (GeV/c)^2. If the cross sections are normalized to the total hadronic cross sections at $q^2 = 0$ and $q^2 = 1.16$ (GeV/c)^2, respectively, we observe that more pions, about an equal number of protons, but fewer kaons are found in the photoproduction case for $x \geq 0.3$. (auth)

25736 (ITEF-900) INTERACTIONS OF HIGH-ENERGY PARTICLES WITH DEUTERONS. Kolybasov, V. M.; Marinov, M. S. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow. Institut Teoreticheskoi i Eksperimental'noi Fiziki). 1971. 36p. (In Russian). INIS.

The available experimental data on the interaction of fast particles with deuterons were compared with the theoretical predictions, based on the concept of the diffraction character of interactions. The Glauber correction to the total cross section defining the structure of the deuteron was first examined. Data on the deuteron form factor, obtained from elastic scattering of electrons, was used for this. A comparison of theory with experiments was reported for the angular distribution of elastic pd, πd, and $\bar{p}$d scattering and also for pd scattering with breakdown of the deuteron. Corrections to the Glauber theory, originating at high energies because of virtual generation of particles (inelastic shielding), were examined. A brief review was given of the basic assumption of the Glauber theory and the precision of the theoretical predictions was considered. (tr-auth)

25737 (JINR-E1-6946) PRELIMINARY EXPERIMENTAL RESULTS ON A SEARCH FOR THE DIRAC MONOPOLE AT THE 70-GeV IHEP SYNCHROTRON USING VAVILOV–CHERENKOV RADIATION. Zrelov, V. P.; Kollarova, L.; Kollar, D.; Lupil'tsev, V. P.; Pavlovic, P.; Ruzicka, J.; Sidorova, V. I.; Shabanov, M. F.; Sulek, P.; Janik, R. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems). 1973. 11p. Dep. NTIS (U. S. Sales Only) $3.00.

The experiment is aimed at the detection of greatly intensive Vavilov–Cherenkov radiation having a peculiar polarization from relativistic magnetic charges (both stable and unstable) by means of the electronic technique. The preliminary results of the experiment are reported: the magnetic charges with g = 68.5 e, the masses up to 5 m and the lifetime $\tau_g > 10^{-10}$ sec are not produced below $\sigma(95\%) < 8 \times 10^{-40}$ cm^2 in 70-GeV proton collisions with nuclear nucleons from a SiO_2 target. (auth)

25738 (LBL-1053) MEASUREMENT OF THE K*(890) MASS DIFFERENCE IN THE REACTIONS $\pi^+d \rightarrow (p)\Lambda K^{*+}$ AND $\pi^-p \rightarrow \Lambda K^{*0}$. Hoch, P. L. (California Univ., Berkeley. Lawrence Berkeley Lab.). 16 Oct 1972. Contract W-7405-eng-48. 44p. Dep. NTIS $4.25.

Thesis.

We have attempted to measure the K*(890) electromagnetic mass difference in two charge-symmetric pairs of $\pi N \rightarrow \Lambda K^*$ reactions. Using data from bubble chamber exposures at $E_{c.m.} =$ 2 to 3 GeV, we have done maximum-likelihood fits to the $\Lambda K\pi$ final states, approximating the peak in m(Kπ) by a simple fixed-width Briet–Wigner. We report a mass difference of $\Delta m \equiv m(K^{*0}) - m(K^{*\pm}) = (-2.7 \pm 4.4)$ MeV; this error is twice the statistical error from the fitting program. The present world average, with this result included, is $\Delta m = (5.2 \pm 1.4)$ MeV. We feel that our result is comparable in quality to those which had been reported when we began this study. The use of charge-symmetric reactions was intended to reduce one possible source of systematic error: peak shifts due to interference with background should cancel in the mass difference. Various systematic effects and statistical limitations have prevented us from getting a good result by this simple expedient, and have apparently given the wrong answer. Our result is inconsistent both with those early results and with a recent and precise determination using a high-statistics, interference-free sample. (auth)

25739 REACTION $e^+e^- \rightarrow p\bar{p}$ AT A TOTAL ENERGY OF 2.1 GeV. Castellano, M.; Di Giugno, G.; Humphrey, J. W.; Sassi

Palmieri, E.; Troise, G.; Troya, U.; Vitale, S. (Istituto Nazionale di Fisica Nucleare, Naples). Nuovo Cim.; 14A: No. 1, 1-20 (1 Mar 1973).

An optical spark-chamber counter experiment at Adone, the Italian colliding electron-positron ring, has succeeded in measuring the cross section for the process $e^+e^- \to p\bar{p}$ near threshold ($E_{c.m.} = 2.1$ GeV). The result is $\sigma(e^+e^- \to p\bar{p}) = (0.91 \pm 0.22)$ nb. (auth)

25740 MULTIHADRON PRODUCTION IN e^+e^- COLLISIONS AT HIGH ENERGY. Grilli, M. (CNEN, Frascati, Italy); Iarocci, E.; Spillantini, P. Nuovo Cim.; 13A: No. 3, 593-644(1 Feb 1973).

Multihadron production by electron-positron colliding beams was investigated for total center-of-mass energies ranging from 1.2 to 2.4 GeV. The total cross section, $\sigma_{tot} \equiv \sigma(e^+e^- \to \pi^+\pi^- +$ anything), is of the order of $\sigma_{\mu\mu} \equiv \sigma(e^+e^- \to \mu^+\mu^-)$, with a threshold near 1 GeV. Partial cross sections for the various channels are also derived. The cross section of the specific channel $e^+e^- \to \pi^+\pi^-\pi^+\pi^-$ exhibits an energy dependence which is suggestive of a heavier vector meson, ρ' ($m_{\rho'} \approx 1.6$ GeV, $\Gamma_{\rho'} \approx 350$ MeV), having the same quantum numbers as the ρ-meson. An upper limit is given for the coupling constant $f_{\rho'}(f_{\rho'}/4\pi < 18$, where $f_{\rho'} = m_\rho^2\, e/g_{\gamma\rho'})$. Final states with G^+ parity are found to be much more abundant than those with G^- parity. The average multiplicity (charged plus neutral final-state pions) is found to be between 4 and 5 over all the energy range explored. (auth)

25741 PROTON–PROTON BREMSSTRAHLUNG AT 156 MeV. Willis, A.; Comparat, V.; Frascaria, R.; Marty, N.; Morlet, M.; Willis, N. (Paris Univ., Orsay, France). J. Phys. (Paris), Colloq.; No. 5, 165(1972). (In French).

The two protons emitted at angles $\theta_1 = 15°$ and θ_2 lying between 18 and 27° in a bremsstrahlung experiment were detected in energy coincidence, and the gamma rays emitted between 115° and 155° were detected in coincidence with the protons. The cross sections obtained are presented. (FR)

25742 PHOTOPRODUCTION OF CHARGED ρ-MESONS IN THE MODEL OF COMPLEX MOMENTA. Grigoryan, R. P.; Amatuni, A. Ts.; Arakelyan, G. G.; Eremyan, Sh. S. (Inst. of Physics, Erevan). Izv. Akad. Nauk Arm. SSR, Ser. Fiz.; 7: No. 4, 235-242(1973). (In Russian).

Using the experimental data on ρ^--photoproduction in deuterium bubble chamber at an average energy $E\gamma = 1.95$ GeV, we have calculated the behavior of the differential cross section for ρ^+-photoproduction at various energies and also the corresponding parity asymmetry. (auth)

25743 PHOTOPRODUCTION OF THE π^- MESONS ON DEUTERIUM NEAR TO THE FIRST RESONANCE. Blum, D.; Boucrot, J.; Grossetete, B.; McGill, W.; Nguyen Ngoc, H. (Ecole Normale Superieure, Orsay, France). J. Phys. (Paris), Colloq.; No. 5, 132(1972). (In French).

The principle and preliminary results of an experiment enabling the complete study of the $\gamma + d \to \pi^- + p + p$ reaction are presented. A photon monochromator was used and more than 100,000 coincidence events were recorded. (France)

Weak

Refer also to abstract 25822.

25744 (IFVE-STF-72-10) $\nu N \to \mu\pi N$ REACTION IN THE ONE PION EXCHANGE APPROACH. Andryushin, V. I.; Kobrinskii, M. N.; Folomeshkin, V. N. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Serpukhov. Institut Fiziki Vysokikh Energii). 1972. 13p. (In Russian). INIS.

It was shown that data on weak vectors of the form factor of π mesons can be obtained from experimental data on the reaction $\nu N \to \mu\pi N$. Together with experimental procedures of the Chew and Low type, requiring comparatively large statistics, a method was proposed for the evaluation of the pion form factor on the basis of the study of the energy spectrum of π mesons in the reaction $\nu N \to \mu\pi N$. (tr-auth)

25745 BETA DECAY OF POLARIZED Λ HYPERONS. III. Correlations in the Λ Center-of-Mass System and the Proton Recoil Spectrum. Althoff, K. H.; Brown, R. M.; Freytag, D.; Heard, K. S.; Heintze, J.; Mundhenke, R.; Rieseberg, H.; Soergel, V.; Stelzer, H.; Wagner, A. (CERN, Geneva). Phys. Lett.; 43B: No. 3, 237-239(5 Feb 1973).

From the analysis of 817 kinematically reconstructed beta decay events of polarized Λ hyperons for the coefficient α_ν of the neutrino correlation with respect to the Λ spin, $\alpha_\nu = 0.89 \pm 0.08$, for the coefficient α_T of the T-odd correlation $\sigma_\Lambda(p_e \times p_\nu)$, $\alpha_T = -0.14 \pm 0.13$. The proton recoil spectrum yields $|g_1/f_1| = 0.64 \pm 0.06$. (auth)

Strong (Baryon-induced)

Refer also to abstracts 24736, 25845, and 26078.

25746 (FRNC-TH-289) STUDY OF THE $K\bar{K}$ AND $K\bar{K}\pi$ RESONANCES IN ANTIPROTON–PROTON ANNIHILATIONS AT 1.1 AND 1.2 GeV/c. Makowski, B. 1972. 125p. (In French). Dep. NTIS (U. S. Sales Only).

Thesis.

An overall investigation of the different reactions producing at least one K_1^0 enabled the production cross sections of resonances to be calculated. The E^0 is clearly distinguished from the $K^*\bar{K}^*$ production. The $K_1^0K^\pm$ structure having unit isospin arises essentially from the disintegration of D^0 and E^0. It can be represented by a diffusion length $|a| = 1.8 \pm 0.4$ fermi. For the $K_1^0K_1^0$ the phenomenon at the threshold must be represented by a resonance: the S^* resonance. Its mass and its width were found to be smaller than when produced in π-nucleon interactions. D^0 is observed in all the reactions where a neutral $K\bar{K}\pi$ system appears. Finally it was possible to determine the spin and parity of the D^0 and to obtain information about the possible quantum numbers for F_1. (auth)

25747 (NAL-80) SMALL ANGLE ELASTIC PROTON–PROTON SCATTERING FROM 25 TO 2000 GeV. Bartenev, V.; Carrigan, R.; Chiang, I. H.; Cool, R. L.; Goulianos, K.; Gross, D.; Kuznetsov, A.; Malamud, E.; Melissinos, A. C.; Morozov, B.; Nikitin, V.; Olsen, S. L.; Pilipenko, Yu.; Popov, V.; Yamada, R.; Zolin, L. (National Accelerator Lab., Batavia, Ill.). Oct 1972. Contract AT(49-8)-3000. 10p. (COO-2232-1; COO-3065-29; UR-412). Dep. NTIS.

We have measured the differential cross section for small angle p-p scattering from 25 to 200 GeV incident energy and in the momentum transfer range $0.015 < |t| < 0.080$ (GeV/c)^2. We find that the slope of the forward diffraction peak, b(s), increases with energy and can be fit by the form $b(s) = b_0 + 2\,\alpha' \ln s$ where $b_0 = 8.3 \pm 1.3$ and $\alpha' = 0.28 \pm 0.13$ (GeV/c)$^{-2}$. Such dependence is compatible with the data existing both at higher and lower energies. We have also obtained the energy dependence of the p-p total cross section in the energy range from 48 to 196 GeV. Within our errors which are ±1.1 mb the total cross section remains constant. (auth)

25748 (SLAC-Trans-153) DIFFERENCES IN TOTAL CROSS SECTION FOR MOMENTA UP TO 65 GeV/c. Gorin, Yu. P.; Denisov, S. P.; Donskov, S. V.; Petrukhin, A. I.; Prokoshkin, Yu. D.; Stoyanova, D. A. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Obninsk. Fiziko-Energeticheskii Institut). Translation of IFVE-SEF-72-59. 1972. 44p. Dep. NTIS $4.25.

Total cross sections for the interaction of π^- and K^- mesons and antiprotons with protons and deuterons have been measured in the momentum range up to 15 to 65 GeV/c. The total cross sections for the particle interactions with neutrons have been found with allowance for the energy dependence of the Glauber correction. With the aid of the total cross section data for positive particles obtained earlier on the same installation the differences of the total cross sections were calculated for particles and antiparticles as well as for particles belonging to the same isospin multiplet. The measured total cross sections and their differences are in agreement with relations predicted on the basis of the quark model and the Regge pole model. (auth)

25749 REACTION $\bar{p}p \to \bar{p}p\pi^+\pi^-$ AT 2.32 GeV/c. Oren, Y. (Argonne National Lab., IL); Cooper, W. A.; Fields, T.; Rhines, D. S.; Whitmore, J.; Allison, W. W. M. Nucl. Phys., B; B53: No. 2, 269-281(26 Feb 1973).

A bubble-chamber study based on 4,906 events of the reaction $\bar{p}p \to \bar{p}p\pi^+\pi^-$ at 2.32 GeV/c is reported. Effective-mass and four-momentum-transfer distributions are given. This reaction is dominated by the peripheral production of $\Delta^{++}\Delta^{--}$. The Δ decay correlation parameters are presented as a function of t. A one-pion-exchange model (OPE) describes only the general features of the data and does not account for the observed correlations. No structure is observed in the $\bar{p}p$ or $\bar{p}p\pi^\pm$ effective-mass distributions. (auth)

25750 ANALYSIS OF THE REACTION $pp \to p(\pi\pi)^0\,p$, IN HIGH ENERGY PRODUCTION PROCESSES. Bonn-Hamburg-Munich Collaboration. Nucl. Phys., B; B53: No. 2, 282-288(26 Feb 1973).

A low-mass S-wave $(\pi\pi)^0$ enhancement is observed in the reaction $pp \to p(\pi\pi)^0\,p$ at 12 and 24 GeV/c incident momentum. The mechanism for producing these low-mass pion pairs is investigated, and it is shown that double pomeron exchange can contribute at most 5% to their production cross section at 24 GeV/c. (auth)

25751 TWO RECENT EMULSION EXPERIMENTS RELATED TO SCALING FOR E > 1 TeV. Jones, L. W.; Lyon, D. E. Jr. (Univ. of Michigan, Ann Arbor). Nuovo Cim.; 13A: No. 3, 837-844(1 Feb 1973).

Two recent papers report data which purport to cast doubt on the validity of "scaling" in inclusive strong interactions above one TeV. It is observed here that those two papers are in disagreement with each other more than with scaling. However, both sets of data are also shown to be not inconsistent with scaling after the inclusion of the experimental biases. (auth)

25752 POLARIZATION EFFECTS IN THE REACTION pp → pN* AT 14 GeV/c. Del Prete, T.; Valdata, M. (Istituto Nazionale di Fisica Nucleare, Pisa, Italy). Nuovo Cim.; 13A: No. 4, 976-982 (21 Feb 1973).

A detailed study of the two-charged-prong events originated by protons hitting a polarized target has shown evidence of polarization effects in the reaction pp → pN*. (auth)

25753 STUDY OF $\bar{p}p \rightarrow \Lambda/\Sigma^0$ + ANYTHING AT 5.7 GeV/c. Ganguli, S. N.; Sadoulet, B. (CERN, Geneva). Nucl. Phys., B: B53: No. 3, 458-472(12 Mar 1973).

A study of the inclusive reaction $\bar{p}p \rightarrow \Lambda/\Sigma^0$ + anything at 5.7 GeV/c based on 9544 events is presented. The main experimental feature is a flattening of the momentum-transfer distribution with the increasing missing mass. An attempt is made to interpret the results in the framework of the triple-Regge limit. The effective trajectory is shown to be in good agreement, within theoretical uncertainties, with what is expected from K or K*-K** exchanges. (auth)

25754 TRANSVERSE MOMENTUM PLOTS FOR ANNIHILATION AND NON-ANNIHILATION PROCESSES. Gregory, P. S. (Univ. of Liverpool); Grossmann, P.; Mason, P.; Muirhead, H.; Holmgren, S. O.; Yamdagni, N. K. Phys. Lett.; 43B: No. 3, 228-230(5 Feb 1973).

Data are presented on the average transverse momentum of the pions produced in annihilation processes. High values are found compared with most nonannihilation channels. This result may be attributed to baryon exchange. (auth)

25755 OBSERVATION OF NARROW $(3\pi)^{\pm}$ PEAKS IN THE δ AND A_1 REGIONS IN $\bar{p}p$ ANNIHILATIONS AT 5.7 GeV/c. Atherton, H. W.; Franek, B. J.; French, B. R.; Ghidini, B.; Hilpert, H. G.; Kinson, J. B.; Mandelli, L.; Moebes, J.; Myklebost, K.; Nellen, B.; Quercigh, E.; Simak, V. (CERN, Geneva). Phys. Lett.; 43B: No. 3, 349-252(5 Feb 1973).

In the $\pi^+\pi^-\pi^{\pm}$ systems of the reactions $\bar{p}p \rightarrow \bar{K}Km\pi(m = 4, 5)$ two narrow peaks are observed at the positions of the δ and A_1 mesons. The measured masses and widths are: M = (956 ± 7) MeV, Γ = (46 ± 22) MeV for the δ and M = (1076 ± 5) MeV, $\Gamma = (36^{+16}_{-12})$ MeV, for the A_1. Their decay modes and spin-parities are shown to be mainly 3π, $J^P = 0^-$ and $\rho\pi$, $J^P = 1^+$ (D-wave) respectively. (auth)

25756 MEASUREMENTS OF THE PROTON-PROTON TOTAL CROSS SECTION BY MEANS OF COULOMB SCATTERING AT THE CERN INTERSECTING STORAGE RINGS. Amaldi, U. (Istituto Superiore di Sanita, Rome); Biancastelli, R.; Bosio, C.; Matthiae, G.; Allaby, J. V.; Bartel, W.; Block, M. M.; Cocconi, G.; Diddens, A. N.; Dobinson, R. W.; Litt, J.; Wetherell, A. M. Phys. Lett.; 43B: No. 3, 231-236(5 Feb 1973).

Proton-proton elastic scattering has been measured at the CERN Intersecting Storage Rings in the four-momentum transfer range $0.001 \leq |t| \leq 0.015$ GeV^2 at center-of-mass energies of 23 and 31 GeV. The detection of Coulomb scattering and of its interference with nuclear scattering leads to the determination of the real part of the nuclear amplitude and of the total proton-proton cross section by the optical theorem. (auth)

25757 BEHAVIOR WITH INCREASING ENERGY OF THE LIMITING DISTRIBUTIONS FOR THE EXCLUSIVE REACTION $pp \rightarrow pp\pi^+\pi^-$ FROM 4 GeV/c TO 25 GeV/c. Dolfini, R. (Univ., Pavia, Italy); Ratti, S.; Cecchet, G.; Impellizzeri, F. Lett. Nuovo Cim.; 6: No. 11, 427-432(17 Mar 1973).

The pion and proton transverse-momentum distributions in the exclusive interaction $p + p \rightarrow p + p + \pi^+ + \pi^-$ are studied as a function of energy using the world data summary at energies 4.0 to 24.8 GeV. Some conclusions of the analysis are summarized as follows: the transverse and longitudinal characteristics of the process are energy dependent for $P_{lab} > 19$ GeV/c; the values of the asymptotic parameter appear to be consistently different from zero. (LBS)

Strong (Meson-induced)

Refer also to abstract 24741.

25758 (COO-1195-250) SEARCH FOR STRUCTURE IN THE $f^0(1260)$ AND $A_2^0(1315)$ MESONS. Holloway, L. E.; Huld, B.; Jordan, M.; Koetz, U.; Kruse, U. E.; Mortara, D. W.; Nodulman, L. J.; Bernstein, S.; Margulies, S.; McLeod, D. W. (Illinois Univ., Urbana; Illinois Univ., Chicago. Dept. of Physics). Dec 1972. Contract AT(11-1)-1195. 13p. Dep. NTIS $3.00.

A high resolution (8 MeV FWHM) spectrometer was used to obtain mass spectra of the A_2^0 and f^0 mesons. The mass spectra of both resonances were fit well by simple Breit-Wigner shapes. For the f^0 meson, the Breit-Wigner shape was definitely favored over a dipole shape, the confidence levels being 92% and 5%, respectively. (auth)

25759 (IFVE-SEF-71-48) ENERGY DEPENDENCE OF π^-, K^-, AND $\bar{p}$ TOTAL CROSS-SECTIONS ON PROTONS IN THE MOMENTUM RANGE UP TO 65 GeV. Denisov, S. P.; Dmitrevski, Yu. P.; Donskov, S. V.; Gorin, Yu. P.; Melnik, Yu. M.; Petrukhin, A. I.; Prokoshkin, Yu. D.; Seleznev, V. S.; Shuvalov, R. S.; Stoyanova, D. A.; Vasileev, L. M. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Serpukhov. Institut Fiziki Vysokikh Energii). 1971. 8p. (In Russian). INIS.

The total cross sections of the interaction of negative pions, kaons, and antiprotons in the momentum range up to 65 GeV/c were measured. The measurements were made with a statistical precision of 0.3 to 0.6% and a systematic error ~0.4%. The data obtained agrees well with the results of earlier experiments. In the momentum range above 30 GeV/c the dependence between the energy and the total cross sections π^-p and K^-p becomes almost a straight line and significantly differs from the results the basis of the Regge pole, obtained at lower energies. The total cross sections agree well with the calculated data. (tr-auth)

25760 (IFVE-SEF-71-50) SIMPLE TARGET FOR PRECISION CROSS SECTION MEASUREMENTS OF INTERACTION OF PARTICLES WITH PROTONS AND DEUTERONS. Gorin, Yu. P.; Denisov, S. P.; Mitin, A. A.; Stoyanova, D. A.; Sytnik, V. V. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Serpukhov. Institut Fiziki Vysokikh Energii). 1971. 9p. (In Russian). INIS.

The construction and characteristics of a target used for the measurement of the total cross sections of the interaction of pions, kaons, and protons with protons and deuterons at the IFVE accelerator are described. Questions connected with the determination of the density of the hydrogen and deuterium are examined. (tr-auth)

25761 (IFVE-SEF-71-100) MEASUREMENTS OF TOTAL CROSS SECTIONS FOR THE PION-PROTON AND PION-DEUTERON INTERACTIONS IN THE MOMENTUM RANGE OF 15 TO 16 GeV/c AND DETERMINATION OF THE GLAUBER CORRECTION. Gorin, Yu. P.; Denisov, S. P.; Donskov, S. V.; Petrukhin, A. I.; Prokoshkin, Yu. D.; Stoyanova, D. A. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Serpukhov. Institut Fiziki Vysokikh Energii). 1971. 14p. (In Russian). INIS.

The total cross sections of the interaction of π^- mesons with protons and deuterons in the momentum range from 15 to 60 GeV/c were measured. The Glauber correction was found by use of the data obtained earlier on this same installation on the total cross sections for π^+ mesons. From the measurement results it follows that the parameter $\langle r^{-2} \rangle$, determining the Glauber correction, increases with increasing momentum. (tr-auth)

25762 (IFVE-SEF-71-103) MEASURING THE MEAN LIFETIME OF π^+-MESON BY OSCILLOGRAPHIC METHOD. Dunaitsev, A. F.; Prokoshkin, Yu. D.; Razuvaev, E. A.; Sergeev, V. A.; Simonov, Yu. N. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Serpukhov. Institut Fiziki Vysokikh Energii). 1971. 25p. (In Russian). INIS.

The mean life-time τ of stopped π^+ mesons was measured by use of a system of meters and a velocity multiwave oscillograph which was used for the multidimension amplitude-time analysis of $\pi \rightarrow \mu$ decays. Owing to the use of traps for positrons from $\mu \rightarrow e$ decays the background was reduced to a level $< 10^{-6}$. The magnitude of τ obtained was equal to 26.09 ± 0.08 nsec. (tr-auth)

25763 (IFVE-SEF-72-20) MISSING-MASS SPECTRA OBSERVED IN $\pi^- + p \rightarrow p + X^-$ AT 25 AND 40 GeV/c. Antipov, Yu. M.; Ech, F. A.; Landsberg, L. G.; Lebedev, A. A.; Busnello, R.; Kintsle-Fokachchi, M. N.; Lekomt, P.; Marten, M.; Vaich, A.; Klanner, R.; Damgaard, G.; Kintsle, V.; Leshanuan, K.; Roinishvili, V. N.; Sard, R. D. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Serpukhov. Institut Fiziki Vysokikh Energii). 1972. 14p. (In Russian). INIS.

The results of the investigation on the mass spectra of boson states with strangeness s = 0 in the mass range $0 < M_{x_s} < 4.5$ GeV and in the range of momentum transfer of $0.17 < |t| < 0.35$ GeV/c were reported. In the area of small mass < 2 GeV peaks with M_x = 1.3 GeV and M_x = 1.7 GeV were noticed. In the area of large mass > 2 GeV the spectrum x^- does not have the statistics of a significant structure. (tr-auth)

25764 (IS-T-572) NON-STRANGE NEUTRAL MESON SPECTRUM FROM $\pi^-p \rightarrow M^0n$ AT 2.4 GeV/c. Jacobel, R. W. (Ames Lab., Iowa). Feb 1973. Contract W-7405-eng-82. 99p. Dep. NTIS $7.00.

Thesis.

The nonstrange neutral meson spectrum from 900 to 1300 MeV has been studied in the reaction negative pion plus proton goes to neutron plus missing mass at an incident beam momentum of 2.4 GeV/c. Neutrons produced by beam interactions in the liquid hydrogen target were detected in the near forward direction in an array of plastic scintillation detectors. The missing mass of the remaining particles produced in the final state was determined by a measurement of the neutron time of flight. In the case of genuine two-body processes, $\pi^-p \rightarrow n$ + meson, the observed neutrons corresponded to mesons produced forward in the center of mass system. Arrays of scintillation detectors surrounding the hydrogen target gave charged particle information which was used to separate the missing mass spectra into different final state categories. The well established η^0, ρ^0 and η' mesons were detected along with evidence for four previously unreported mesons. These mesons, appearing as narrow enhancements in the missing mass spectrum, were found in subsets of the two-charged final state category at masses of approximately 940, 963, 1033, and 1150 MeV. (auth)

25765 (JINR-P1-6845) DETERMINATION OF THE LOWER BOUNDARY FOR A π^-p INTERACTION EFFECTIVE RADIUS AT 5 GeV/c AND ITS DEPENDENCE ON THE ENERGY. Glagolev, V. V.; Konstantinesky, A.; Emel'yanenko, V. N.; Lebedev, R. M.; Saitov, I. S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy). 1972. 11p. (In Russian). (CONF-720954-19). Dep. NTIS (U. S. Sales Only).

From sixteenth international conference on high energy physics; Batavia, Illinois, USA (6 Sep 1972).

The lower boundary of the effective radius for inelastic interaction processes is determined. Its dependence on the energy and number of produced mesons is studied. (auth)

25766 (LBL-1547) PROPERTIES OF THE $B^+(1235)$ MESON PRODUCED IN π^+p INTERACTIONS AT 7.1 GeV/c. Ott, R. L. (California Univ., Berkeley. Lawrence Berkeley Lab.). 15 Sep 1972. Contract W-7405-eng-48. 68p. Dep. NTIS $5.50.

The mass, width, D/S ratio, production cross section and branching ratios of the $B^+(1235)$ meson are determined from the reaction $\pi^+p \rightarrow B^+(1235)$ p at 7.1 GeV/c. Chung and Berman–Jacob analyses of the $\omega\pi$ decay angular distributions show that the spin–parity of the B(1235) is $J^P = 1^+$ or $2^+, 3^-, \ldots$. The mass, width, and D/S ratio, determined from an analysis of the mass and decay angular distributions assuming that the spin–parity of the B(1235) is $J^P = 1^+$, are found to be $E_R = 1.252 \pm 0.006$ GeV, $\Gamma^R = 0.156^{+0.0}_{-0.0}{}^{+0.01}_{-0.01}$ GeV, and $\Gamma^R_S/\Gamma^R_D = 0.00^{+0.0}_{-0.0}{}^{+0.0}_{-0.0}$ which indicates that the decay is entirely S-wave. The B(1235) production cross section is found to be 42^{+4}_{-4} μb at this momentum and upper limits for the branching ratios for the decay of the B(1235) into other possible channels relative to $\omega\pi$ were determined to be $\pi^+\pi^0/\omega\pi < 0.15$, $\eta\pi^+/\omega\pi < 0.15$, $K^+\bar{K}^0/\omega\pi < 0.08$, and $\phi\pi^+/\omega\pi < 0.025$ with 90% confidence level. (auth)

25767 (ORO-2504-189) STUDY OF THE $\pi^-p\bar{K}^0$, $\pi^-\pi^+n\bar{K}^0$, AND $\pi^-p\pi^0\bar{K}^0$ FINAL STATES FROM K^-p INTERACTIONS AT 2.9 GeV/c. Khoury, B. V. (Maryland Univ., College Park. Dept. of Physics and Astronomy). Jun 1972. 118p. Dep. NTIS $8.00.

Thesis.

The final states $\pi^-p\bar{K}^0$, $\pi^-\pi^+n\bar{K}^0$, and $\pi^-p\pi^0\bar{K}^0$ resulting from K^-p interactions at an incident beam momentum of 2.87 GeV/c are analyzed. The data constitute part of the study of about one million pictures taken at the 31" bubble chamber at Brookhaven National Laboratory. This experiment represents the collaborative efforts of Brandeis, Maryland, Syracuse, and Tufts Universities. There is a very large sample of $K^*(890)$ mesons produced in each of the final states. The production and decay characteristics of this resonance are presented and are consistent with previously published results. A lesser amount of the $K^*(1400)$ is observed and its properties are also considered. The spin space density matrix elements for each of these meson resonances are presented as a function of four-momentum transfer squared. Amounts of each of the resonances present in these three final states are found along with their production and decay characteristics. (auth)

25768 ELECTROPRODUCTION OF ρ^0 MESONS AT $0.3 < Q^2 < 1.5$ GeV^2 AND $1.7 < W < 2.8$ GeV. Eckardt, V. (Deutsches Elektronen-Synchrotron, Hamburg); Gebauer, H. J.; Joos, P.; Meyer, H.; Naroska, B.; Notz, D.; Podolsky, W. J.; Wolf, G.; Yellin, S.; Drews, G.; Nagel, H.; Rabe, E. Phys. Lett.; 43B: No. 3, 240-244 (5 Feb 1973).

Production and decay characteristics of electroproduced ρ mesons were studied in the final state $ep\pi^+\pi^-$. (auth)

25769 MEASUREMENT OF THE PION–NUCLEON CHARGE-EXCHANGE REACTION $\pi^- + p \rightarrow \pi^0 + n$ AT 22.6, 32.9, AND 42.6 MeV. Duclos, J. (CEN de Saclay, Gif-sur-Yvette, France); Gerard, A.; Magnon, A.; Miller, J.; Morgenstern, J.; Bertin, P. Y.; Coupat, B.; Montret, J. C.; Michel, B.; Vernin, P. Phys. Lett.; 43B: No. 3, 245-248(5 Feb 1973).

We have determined the pion charge exchange cross section on hydrogen for π^0 mesons emitted at 180° by measuring neutron time-of-flight. Using known values of the p-wave phase shifts we have deduced the contribution of the s-wave. We obtain a value for the quantity $a_1 - a_3$ (in $h = c = m = 1$ units where m is the pion mass) $= 0.270 \pm 0.014$ in agreement within the errors with recent theoretical calculations. We also find a value of 114 ± 55 μb/sr for the cross section in the center of mass system for radiative pion capture at 22.6 MeV (gamma ray emitted at 180°). (auth)

25770 SCALING PROPERTIES OF THE INCLUSIVE REACTION $K^- + p \rightarrow \Lambda$ + ANYTHING. Aachen-Berlin-CERN-London-Vienna-Amsterdam-Nijmegen Collaboration. Nucl. Phys.; 39B: 133-140(1972).

The scaling properties of the reaction $K^- + p \rightarrow \Lambda$ + anything are studied at 4.2 and 10.1 GeV/c. In this energy range, the reaction is peculiar, as it practically coincides with the hypercharge annihilation reaction $K^- + p \rightarrow \Lambda$ + pions and has a cross section rapidly decreasing with increasing energy. It is found that while the Feynman function $(E^*/p^*_{max})/(d\sigma/dx)$ and the function $d\sigma/dx$ do not scale in the energy range studied, the distributions at 4.2 and 10.1 GeV/c of the function $(1/\sigma(\Lambda))/(d\sigma/dx)$, where $\sigma(\Lambda)$ is the cross section for Λ-production, coincide over the entire x-range. Comments are made on the facts that this inclusive reaction is undeveloped and that the hypercharge annihilation reaction is neither inclusive nor exclusive. (auth)

25771 KNπ FINAL STATES IN K^+p INTERACTIONS AT 7.3 GeV/c. Mellema, D. J. (Univ. of California, Los Angeles). Nucl. Phys.; B53: No. 3, 429–457(12 Mar 1973).

Data are presented on the production of the KNπ final states in K^+p interactions at 7.3 GeV/c. The energy dependence of the KNπ final state cross sections, the effective mass distributions, and the spectra of c.m. longitudinal momenta are given, and features of these data are compared with predictions of the generalized Veneziano (GV) model. Futhermore, the momentum transfer and decay angular distributions for $K^*(890)$, $K^*(1420)$, and $\Delta(1236)$ production within the KNπ final states are presented and these quasi-two-body reactions are discussed in terms of the GV model. (auth)

25772 $K^-\pi^+\pi^-d$ AND $K^-\pi^+\pi^-n$ FINAL STATES IN K^-d INTERACTIONS AT 3.4 GeV/c. Nicholas, M. L.; Kwak, N.; Eckert, R. R.; Stump, R. (Univ. of Kansas, Lawrence). Nuovo Cim.; 14A: No. 2, 363-385(21 Mar 1973).

The two reactions $K^-d \rightarrow K^-\pi^+\pi^-d$ and $K^-d \rightarrow K^-\pi^+\pi^-np$, were studied in the 30 in. MURA bubble chamber. The cross sections were (130 ± 30) and (1530 ± 180) μb respectively. The final state $K^-\pi^+\pi^-d$ was found to be dominated by $K^*(890)$ production, while the final state $K^-\pi^+\pi^-n$ proceeded substantially through the production of the double resonances $K^{*0}(890)$ $\Delta^-(1236)$. The coherent reaction agrees fairly well with a multiperipheral model. The decay density matrix elements are presented in both the Gottfried-Jackson and helicity frames. (auth)

25773 TWO-PARTICLE CORRELATIONS IN THE INCLUSIVE INTERACTIONS FROM 50 TO 10^5 GeV. Imaeda, K. (Inst. for Advanced Studies, Dublin); Agnese, A. G. Lett. Nuovo Cim.; 6: No. 11, 415-419(17 Mar 1973).

The two-particle correlations at primary energies from 50 GeV to 10^5 GeV for the πN and NN interactions produced by cosmic-ray particles in collision with the light nuclei (H, C, N, O) in nuclear emulsion are reported. It is found that the two-particle correlations are positive at energies greater than 500 GeV both for NN and πN interactions. (LBS)

25774 DIFFERENTIAL CROSS SECTION AND POLARIZATION IN THE REACTION $\pi^+n \rightarrow K^+\Lambda$ AT 5.1 GeV/c. Mettel, D. (Faculte des Sciences, Paris); Ghidini, B. Lett. Nuovo Cim.; 6: No. 12, 437-442(24 Mar 1972).

A study is made of the differential cross sections for $\pi^+n \rightarrow K^+\Lambda$ and $\pi^+n \rightarrow K^+\Sigma^0$ interactions and of Λ polarization in $\pi^+n \rightarrow K^+\Lambda$ from 124 events selected from a sample of about 2000 selected events of strange-particle production in π^+d interactions at 5.1 GeV/c. The results are compared to previously obtained results at lower and higher energies, and the interpretation is discussed in the framework of the Regge–pole model. (LBS)

Particle Interactions and Properties (Theoretical)

General

Refer also to abstract 25921.

25775 (IFVE-STF-71-18) LIMITATIONS ON BEHAVIOR OF CROSS SECTIONS OF ELASTIC AND INELASTIC PROCESSES AT HIGH ENERGIES. 3. UNITARITY CONDITION AND ANALYTICITY OF AMPLITUDE OVER COS THETA. Logunov, A. A.; Mestvirishvili, M. A.; Khrustalev, O. A. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Serpukhov. Institut Fiziki Vysokikh Energii). 1971. 30p. (In Russian). INIS.

It was shown that unitarity conditions make it possible to expand the range of the analyticity of scattering as a function of the momentum transfer and analyticity over cos θ of the differential cross section of any inelastic process. It was indicated that the total cross section of the interaction can not increase with increase of the energy higher than $\ln^2 s$. Limitations were obtained on the behavior of the differential cross section of inelastic forward processes at high energy. The character of the dependence of the partial wave was evaluated from the orbital moment at large orbital moments. (tr-auth)

25776 (IFVE-STF-71-19) LIMITATIONS ON BEHAVIOR OF CROSS SECTIONS OF ELASTIC AND INELASTIC PROCESSES AT HIGH ENERGIES. 4. Short Range Action of Nuclear Forces and Cross Section Behavior. Logunov, A. A.; Mestvirishvili, M. A.; Khrustalev, O. A.; Nguen Van Kh'eu (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Serpukhov. Institut Fiziki Vysokikh Energii). 1971. 28p. (In Russian). INIS.

The conception of the effective radius of interactions was broadly used in the present study. Limitations were established on the behavior of the cross sections of elastic and inelastic processes. Questions were examined on the parity of the total cross section of the interaction of particles and antiparticles. (tr-auth)

25777 (IFVE-STF-71-20) LIMITATIONS ON BEHAVIOR OF CROSS SECTIONS OF ELASTIC AND INELASTIC PROCESSES AT HIGH ENERGIES. 5. DECREASE OF DIFFERENTIAL CROSS SECTION FOR MULTIPARTICLE PRODUCTION WITH ENERGY INCREASE. Logunov, A. A.; Mestvirishvili, M. A.; Khrustalev, O. A. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Serpukhov. Institut Fiziki Vysokikh Energii). 1971. 37p. (In Russian). INIS.

It was shown that the differential cross section of inelastic processes at fixed angle of generation decreases with increase of the energy. (tr-auth)

25778 (IFVE-STF-71-38) MECHANISM OF FAST PARTICLE PRODUCTION AT HIGH ENERGIES. Likhoded, A. K. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Serpukhov. Institut Fiziki Vysokikh Energii). 1971. 13p. (In Russian). INIS.

The contribution of single-peripheral process (processes with exchange of one Reggeon) in the spectra of secondary particles was examined. It was shown that such processes described well the energy fraction of proton spectra, but are not in a position to describe the spectra of π mesons. (tr-auth)

25779 (IFVE-STF-71-44) INELASTIC PROCESSES AT HIGH ENERGIES AND EFFECTIVE QUASIPOTENTIAL. Rcheulishvili, G. L.; Savrin, V. I.; Tyurin, N. E.; Khrustalev, O. A. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Serpukhov. Institut Fiziki Vysokikh Energii). 1971. 14p. (In Russian). INIS.

In the framework of the classical examination the effective quasipotential of the interaction of fast hadrons was reconstructed according to the contribution of the inelastic channels under conditions of unitarity in the case of two different distributions with respect to the number of secondary particles. The probability interpretation of inelastic processes at high energies was used. (tr-auth)

25780 (IFVE-STF-71-107) CONNECTION BETWEEN DIFFRACTION PEAK SLOPES OF HIGH-ENERGY BACKWARD AND FORWARD SCATTERING. Arkhipov, A. A.; Savrin, V. I. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Serpukhov. Institut Fiziki Vysokikh Energii). 1971. 9p. (In Russian). INIS.

The amplitude of the elastic scattering was calculated with consideration of the symmetry characteristic of the amplitude in flat quasipotential models. The phases of the elastic scattering were assigned in the form of Born integrals. The relation between diffraction peak slopes of backward and forward scattering was found. (tr-auth)

25781 (IFVE-STF-71-114) PROPERTIES OF THE SCATTERING AMPLITUDE PHASE OVER TRANSFERRED MOMENTUM AND BEHAVIOR OF THE DIFFRACTION PEAK WIDTH AT HIGH ENERGIES. Volkov, G. G. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Serpukhov. Institut Fiziki Vysokikh Energii). 1971. 13p. (In Russian). INIS.

The relation of the limitation on the asymptotic behavior of the diffraction peak widths with the behavior of the scattering amplitude phase in the region $t \gg 0$, $s \to \infty$ was investigated. (tr-auth)

25782 (IFVE-STF-71-118) BOUNDS FOR THE DIFFERENTIAL CROSS SECTIONS DEFINED BY NEAREST SINGULARITIES. Ezhela, V. V. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Serpukhov. Institut Fiziki Vysokikh Energii). 1971. 15p. (In Russian). INIS.

The limitations on the differential cross sections $d\sigma_{el}/d\cos\theta\,(s,\theta)$ and $d\sigma_{inel}/c\cos\theta\,(s,\theta)$ at $s \to \infty$ and $\theta = 0,\pi$ were obtained. (tr-auth)

25783 (JINR-P2-6932) FEYNMAN-GAS STATISTICS. Dushutin, N. K.; Mal'tsev, V. M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 19p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

The Feynman analogy between secondary particles (produced in interaction) and some gas or "liquid" is of particular interest in studying the high energy particle interaction. Some new models and known ones can be obtained when solving the basic kinetic equations under the corresponding assumptions on the character of interaction in Feynman-gas. Thus, we have shown, that the ideal gas corresponds to the multiperipheral production mechanism of secondary particles, fluctuations correspond to the resonance mechanism, and some "liquid" corresponds to the fragmentation of initial particles. (auth)

25784 (NP-19669) INTERNATIONAL SCHOOL FOR YOUNG SCIENTISTS IN HIGH ENERGY PHYSICS. (A series of lectures given August 20–31, 1971 at Gomel, USSR). (Joint Inst. for Nuclear Research, Dubna (USSR)). 1972. 245p. (In Russian). Dep. NTIS (U.S. Sales Only).

The series of lectures deals with problems in theoretical and experimental physics in the field of high energies. The subject matter of the lecture series includes relativistic kinematics, lepton structure, deuteron Compton effect, π-capture, hadron diffraction, neutral kaon scattering, weak interactions at high energies, and the formation of atoms in reactions and in elementary particle decay. (KSW)

25785 (NP-19699) INCLUSIVE MASS DEPENDENCE OF THE MOMENTUM TRANSFER DISTRIBUTIONS IN THE DUAL RESONANCE MODEL. Vallinkoski, M. K.; Raitio, R. O. (Helsinki Univ. (Finland). Research Inst. for Theoretical Physics). Sep 1972. 16p. Dep. NTIS (U. S. Sales Only) $3.00.

We calculate the diagrams which contribute in the single Regge limit ($s \to \infty$, momentum transfer and missing mass fixed and small) in inclusive reactions using the discontinuity of the dual six-point function. We investigate numerically the mass dependence of the momentum transfer distributions in the low missing mass region. (auth)

25786 ASYMPTOTIC BEHAVIOR IN SOME EIKONAL MODELS FOR PRODUCTION. Calucci, G. (Univ., Trieste, Italy). Nucl. Phys., B; B53: No. 2, 313-322(26 Feb 1973).

The high-energy behavior of the total cross section is investigated in the frame of eikonal models for high-energy production processes. The dynamics is introduced by means of phenomenological Hamiltonians; the results are compared with the results of other kinds of dynamics, particularly with some procedure of unitarization of the multiperipheral model. (auth)

25787 HIGH ENERGY PHYSICS INDEX. Volume 11, No. 4, 1973. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1973). 106p.

25788 BARE CURRENT-QUARK MASSES, INELASTIC REACTIONS, AND LIGHT-CONE ALGEBRA. Das, T.; Pandit, L. K.; Roy, P. (Tata Inst. of Fundamental Research, Bombay). Nucl. Phys.; B53: No. 3, 567-583(12 Mar 1973).

Relations connecting the effective bare current-quark masses with asymptotic meson–nucleon and lepton–nucleon scattering are derived by making use of the extended light-cone algebra which includes commutators of pseudoscalar densities. The commutators are relevant to meson–nucleon scattering amplitudes since the pseudoscalar densities act as fields of the (composite) mesons. Assuming pomeron-exchanged Regge behavior, sufficient analyticity in the meson mass-squared variable is established to obtain finite-mass dispersion and superconvergence relations. Making additionally certain other reasonable assumptions, it is then shown how these relations yield testable connections among the asymptotic πN and KN total cross sections, the structure functions of the deep inelastic lepton-nucleon scattering (for the scaling variable, $\xi \to 0$) and the bare current-quark masses $\mu_{p,n,\lambda}$ that appear essentially as parametrizing the breaking of the chiral SU(3) ⊗ SU(3) symmetry. One interesting consequence of our results is that the Llewellyn-Smith inequality on the said structure functions should be experimentally satisfied as a near equality for $\xi \to 0$, if chiral SU(2) ⊗ SU(2) turns

out to be a rather good symmetry of nature. Moreover, taking the specific symmetry breaking model of Gell-Mann, Oakes and Renner, we find that $\mu_{p,n} \approx 35$ MeV and $\mu_\lambda \approx 800$ MeV. (auth)

25789 LARGE TRANSVERSE MOMENTA IN THE MULTIPERIPHERAL MODEL. Amati, D.; Caneschi, L.; Testa, M. (CERN, Geneva). Phys. Lett.; 43B: No. 3, 186-190(5 Feb 1973).

A unified picture of small and large transverse momenta is provided by the multiperipheral model in its original version. The large k_T spectrum is k_T^{-p} times a scaling function. Results are in agreement with ISR data and testable predictions are made. (auth)

25790 REGGEIZED VERTEX FUNCTIONS AND PROPAGATORS. O'Leary, T. Los Angeles; Univ. of California (1972). 174p. University Microfilms Order No. 73-1720.

Thesis (Ph. D.).

Vertex functions and propagators are well-known ingredients of calculations in elementary particle theory. A generalization of these functions to the realm of composite particles is undertaken, yielding Reggeized vertex functions and propagators. It is assumed that these generalized functions possess the same cut and unitarity properties as the analogous elementary particle functions. In addition, composite particles are represented by moving Regge poles, in contrast to the stationary poles of elementary particle theory. Three different approaches are used to solve this problem: 1) S-matrix techniques give the complete relativistic solution. 2) Potential theory yields a non-relativistic solution. 3) Perturbation theory is used to evaluate fourth and sixth order Feynman diagrams. It is found that to this order the results exponentiate to give a representation of the vertex function of the D.G.S. form, but displayed the Regge behavior explicitly. The solutions using S-matrix techniques and potential theory techniques relate the vertex functions and propagators to the original scattering amplitude which is assumed to be known from the start. The Coulomb potential is used as a solvable example. In the course of the proof, using potential theory, several new results emerge. An integral equation for the off-shell N-function is derived which involves only the matrix element of the potential and an integration along the right-hand cut. (The D-function is not involved.) A valuable relationship between the form factor and the off-shell amplitude is also proved. (Diss. Abstr. Int., B)

25791 APPROXIMATION FORMULA AND ALGOL PROGRAM OF THE LORENTZ-INVARIANT MOMENTUM-SPACE INTEGRAL FOR PARTICLES OF EQUAL MASSES. Jabs, A. (Univ., Trier Kaiserslautern, Ger.). Comput. Phys. Commun.; 5: No. 3, 217-224(Mar 1973).

The program LIMS written in ALGOL 60 for the Univac 1108 is described for the Lorentz-invariant momentum-space integral for equal-mass particle interactions at high energies. (JFP)

Electromagnetic

Refer also to abstracts 25736, 25948, 25970, 26083, and 26154.

25792 (DESY-72/76) LINEAR STOCHASTIC PROCESSES AND INTENSITY CORRELATIONS OF PHOTON STATES. Roepstorff, G. (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). Dec 1972. 27p. Dep. NTIS (U. S. Sales Only) $3.50.

We introduce linear stochastic processes on certain function spaces pertinent to the measurement of the intensity correlations that characterize quantized electromagnetic radiation. Next, we construct the characteristic functional of the basic process by considering second quantization as a functor. Finally, we calculate and discuss the characteristic functionals for specific photon states which are: coherent states, quasi-free states, and n-particle states. (auth)

25793 (DESY-72/77) TWO-PHOTON PROCESSES IN THE PARTON MODEL. Walsh, T. F.; Zerwas, P. (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). Dec 1972. 13p. Dep. NTIS (U. S. Sales Only) $3.00.

We study here some two-photon processes in colliding e^+e^- beam reactions, with the aim of testing the parton model. The parton contributions should dominate in certain well defined kinematical limits, and provide an essential difference between photonic and hadronic processes. (auth)

25794 (IFVE-OP-71-37) ELLIPSOIDAL REPRESENTATION OF CHARGED PARTICLE BEAMS. Kartashev, V. P. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Serpukhov. Institut Fiziki Vysokikh Energii). 1971. 13p. (In Russian). INIS.

An ellipsoidal concept of charged particle beams was examined in the space R^n (n = 2,3,...). The formulas obtained for envelloping and distribution of the beam were obtained on the assumption of a uniform beam density in the ellipsoid. (tr-auth)

25795 (IFVE-STF-71-61) BOSON PAIR PRODUCTION BY STATIC FIELD. Arbuzov, B. A.; Rochev, V. E. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Serpukhov. Institut Fiziki Vysokikh Energii). 1971. 11p. (In Russian). INIS.

The threshold behavior of the probability of the production of a pair of scalar bosons in a strong static field was investigated. A sufficiently broad rectangular potential hole and hole with diffuse edges, in which the width of part of the fast conversion of the potential was comparable with the Compton lines of the particle waves, were examined. (tr-auth)

25796 (ISS-72/3) DRELL-HEARN SUM RULE AND THE LEPTON MAGNETIC MOMENT IN THE WEINBERG MODEL OF WEAK AND ELECTROMAGNETIC INTERACTION. Altarelli, G.; Cabibbo, N.; Maiani, L. (Istituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica). 4 Apr 1972. 16p. Dep. NTIS (U. S. Sales Only) $3.00.

We verify that the fourth order Compton amplitude for the scattering of a photon off a charged lepton is finite in Weinberg's model of weak and electromagnetic interactions, and obeys the Drell-Hearn sum rule. We also compute the second order weak corrections to the anomalous magnetic moment of a charged lepton in the same model. For the case of the muon, we find the bounds: $+0.2 \cdot 10^{-8} \leq \kappa \leq +0.56 \cdot 10^{-8}$. (auth)

25797 (ISS-72/8) HADRON MULTIPLICITIES IN A SCALING MODEL FOR e^+e^- ANNIHILATION. Altarelli, G.; Maiani, L. (Istituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica). 2 May 1972. 14p. Dep. NTIS (U. S. Sales Only) $3.00.

We present a study of the annihilation of a vector current into spinless particles in the framework of the ladder model. On the basis of the results reported, we are led to conjecture that in e^+e^- annihilation into hadrons a finite limit for the multiplicity of any type of particle produced will be attained at large q^2 together with a scaling regime for total cross section ($\sigma_{e^+e^-} \sim 1/q^2$). (auth)

25798 (ISS-72/10) DEEP INELASTIC PROCESSES IN LADDER MODELS. Altarelli, G.; Maiani, L. (Istituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica). 19 Jun 1972. 53p. Dep. NTIS (U. S. Sales Only) $4.75.

The structure functions of deep inelastic scattering and of deep inelastic annihilation of a current in the g ϕ^3 theory are studied in the ladder approximation. To this aim an integral equation which is the scaling limit of the classical ABFST equation is used. By solving this equation in a particular case we obtain in closed form the sum of all ladder diagrams with all massless rungs except for the first and the last ones which are given arbitrary masses. The solution is a hypergeometric function in two variables and its analyticity properties in the scaling variable ω, for fixed values of the external mass, are studied. The structure function for annihilation turns out to be, in this case, the analytic continuation of the scattering structure function. Going beyond this particular solution we show in general from the integral equation that the average multiplicity of the secondary particles in the annihilation region approaches a finite limit for increasing q^2, q_μ being the four momentum of the current. Implications of this result for e^+e^- annihilation into hadrons are discussed. (auth)

25799 (JINR-P2-6943) EFFECT OF THE CHOICE OF THE $\pi\pi$-SCATTERING PHASE PARAMETRIZATION ON THE $\gamma + \gamma \to \pi + \pi$ AND $\gamma + \gamma \to \gamma + \gamma$ REACTION CROSS SECTIONS. Isaev, P. S.; Khleskov, V. I. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 19p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

The cross sections of the processes $\gamma + \gamma \to \pi + \pi$ and $\gamma + \gamma \to \gamma + \gamma$ for the case, when the $\pi\pi$ phase shifts are going to π in the asymptotic regions, have been obtained. The importance of the use of the general solution of the homogeneous integral equation for obtaining the solution of the integral dispersion relation has been pointed out. (auth)

25800 (N-72-28723) QUANTUM MECHANICS AS RELATIVISTIC STATISTICS (THE CASE OF INTERACTING PARTICLES). Rylov, Yu. A. Translation of Pr-86 NASA-TT-F-14372. 1971. 31p. NTIS.

It is shown that nonrelativistic quantum mechanics of two particles interacting with an external electromagnetic field and with each other can be considered as the statistics of two-dimensional surfaces representing the state of the system consisting of two nondeterministic particles in eight-dimensional space. This space is the direct product of the space-times for each particle. (auth) (INIS)

25801 ANTINEUTRINO-ELECTRON SCATTERING WITH A STUDY OF γ-QUANTA. Kerimov, B. K.; Tsvetkov, V. P. (Mos-

cow State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 10, 2203-2208(Oct 1972). (In Russian).

Expressions were obtained for angular and energy distributions of hard photons in the process $\bar{\nu}_e + e^- \rightarrow \bar{\nu}_e + e^- + \gamma$. From the foregoing it follows that the cross section for photon emission in $\bar{\nu}_e e^-$ scattering increases with an increase in the energy ($E_\nu > 1$ GeV) of the incident antineutrinos. A study of the peculiarities of the photon spectrum makes it possible to obtain information concerning the nature of weak diagonal $(\bar{e}\nu_e)(\bar{\nu}_e e)$ interactions. The total cross section of $\bar{\nu}_e e^-$ scattering was calculated allowing for all possible electromagnetic effects of the order α. (1 table) (tr-auth)

25802 ASSESSMENT OF THE EQUIVALENT PHOTON APPROXIMATION FOR THE PROCESS $e\bar{e} \rightarrow \pi^+\pi^-$. Brown, C. J.; Lyth, D. H. (Univ. of Lancaster, Eng.). Nucl. Phys., B; B53: No. 2, 323-348(26 Feb 1973).

The contribution of the virtual process $\gamma\gamma \rightarrow \pi^+\pi^-$ is evaluated, first treating the quantum electrodynamics exactly and then using the equivalent photon approximation. The dependence on electron scattering angles, electron energies, $\pi\pi$ invariant mass and $\gamma\pi$ momentum transfer is investigated. The approximation is very good if both electron scattering angles are less than 0.1 rad, but is 20%–40% too big (depending on the precise version used) if either angle is integrated over. It is explained that the approximation is not Lorentz invariant; numerical results are given only for beams with antiparallel momenta. (auth)

25803 PHOTON SPECTRAL FUNCTION. Kuehn, J. (Max-Planck Institut fuer Physik und Astrophysik, Munich). Nuovo Cim.; 14A: No. 1, 52-64(1 Mar 1973).

The completeness of the spectrum of the translation generators P_μ is investigated in the framework of the Gupta-Bleuler formalism of QED. From the self-adjointness of P_μ that the photon spectral function $\rho_{\mu\nu}$ is a measure. This latter property is proved in perturbation theory. The low-energy behavior of $\rho_{\mu\nu}$ is exhibited. (auth)

25804 ANALYTIC INVARIANT AMPLITUDES FOR PROCESSES INVOLVING PHOTONS AND PARTICLES OF ARBITRARY SPIN AND DISPLAYING DISCRETE SYMMETRIES. Stern, H. (CEN de Saclay, Gif-sur-Yvette, France). Nuovo Cim., A; 13A: No. 3, 715-746(1 Feb 1973).

The construction of a complete and minimal set of Lorentz-invariant amplitudes is considered which describe respectively the electromagnetic interaction of a photon and of a hadron of spin s, the electromagnetic decay of a hadron of spin r into a photon and a hadron of spin s, the inelastic photoproduction of a pion on a target of spin r and the Compton effect on a hadronic target of spin s. These amplitudes are free of kinematical zeroes and singularities and transform in a trivial fashion under discrete symmetries. Finally the expressions of the transition amplitudes for these processes and interactions in terms of the invariant amplitudes satisfy transversality and current conservation. (auth)

25805 VIRTUAL PARTICLE EFFECTS IN DEUTERON ELECTROMAGNETIC STRUCTURE. Chemtob, T.; Moniz, E. J.; Rho, M. (CEN de Saclay, Gif-sur-Yvette, France). J. Phys. (Paris), Colloq.; No. 5, 140(1972).

It is shown that the contribution of virtual meson exchanges could modify the present understanding of nuclear electromagnetic form factors at high momentum transfer. (FR)

25806 HIGH-ENERGY γ-RAY SCATTERING BY NUCLEONS AND NUCLEI IN QUARK MODEL. Akhiezer, A. I.; Rekalo, M. P. (Physical-Technical Inst., Kharkov). Ukr. Fiz. Zh. (Russ. Ed.); 18: No. 1, 4-12(Jan 1973). (In Russian).

The total cross sections of γN-interactions are connected with the total cross sections of π- and K-meson interactions with nucleons in the quark model. The predicted energy dependence of the total cross sections of γN-interaction and predicted inequality $\sigma_t(\gamma p) > \sigma_t(\gamma n)$ are in agreement with the experimental data. Real parts of the forward γN-scattering amplitude and differential cross sections of the γN-scattering are calculated. The quark mechanism is suggested for the processes of γ-ray scattering by nuclei which takes into account the rescattering effects in a general form. The predicted A-dependence of the total cross sections of the γN-scattering contradict the experiment indicating the violation of the vector dominance model. (auth)

25807 SEMI-PHENOMENOLOGICAL FITS TO NUCLEON ELECTROMAGNETIC FORM FACTORS. Iachello, F. (Univ. of Copenhagen); Jackson, A. D.; Lande, A. Phys. Lett.; 43B: No. 3, 191-196(5 Feb 1973).

Several theoretically interesting forms of the nucleon EM form factor have been considered and found to provide quantitative descriptions of available data with as few as three adjustable parameters. (auth)

25808 IS IT TRUE THAT THE RESIDUE OF THE J = 0 FIXED POLE IN NEUTRON COMPTON SCATTERING IS ZERO? Biyajima, M. (Osaka Univ.). Phys. Lett.; 43B: No. 3, 197-200(5 Feb 1973).

By making use of a finite energy sum rule (with cutoff energy 4 GeV), the ratio of the residue of the J = 0 fixed pole of neutron Compton scattering to that of proton Compton scattering is found to be about $\frac{2}{3}$. We also find $\beta_{A_2}/\beta p' = 0.18$. (auth)

25809 EXPERIMENTAL LIMITS ON THE VALUES OF ANOMALOUS DIMENSIONS. Parisi, G. (CNEN, Frascati, Italy). Phys. Lett.; 43B: No. 3, 207-208(5 Feb 1973).

We show how to use the data on deep inelastic e–p scattering to put bounds on the values of the anomalous dimensions of the operators involved in the Wilson expansion of the product of two currents near the light cone. Anomalous dimensions of the order of unity are found not to be in contradiction with present experimental evidence. (auth)

25810 RELATION BETWEEN DEEP INELASTIC SCATTERING AND ANNIHILATION. Dahmen, H. D.; Steiner, F. (CERN, Geneva). Phys. Lett.; 43B: No. 3, 217-221(5 Feb 1973).

Locality and spectrum properties are used to derive representations for the scaling functions of deep inelastic scattering and annihilations processes. A generalized crossing relation among these scaling functions emerges. (auth)

25811 THEORETICAL INVESTIGATIONS OF THE ASYMMETRY OF PION PHOTOPRODUCTION WITH A POLARIZED TARGET. Kramer, G. (Univ., Hamburg). Fortschr. Phys.; 19: No. 11, 725-755(1971). (In German).

The theoretical importance of experiments with polarized targets for pion photoproduction at high energies is discussed. In an introductory chapter the basic formulas and simple Regge pole models are introduced in connection with elastic pion–proton scattering. The relevance of Regge-cut models is considered in connection with pion-charge-exchange scattering. In the main part formulas are written down for the polarization parameters in terms of the helicity amplitudes for pion photoproduction. Then the target asymmetry A for photoproduction of neutral and charged pions is considered. Several models with Regge poles and Regge cuts generated by absorption are presented and discussed concerning the results for A. In the last part a fit to $\pi^\pm$ photoproduction data is reported and predictions of A for $\gamma p \rightarrow \pi^+ n$ and $\gamma n \rightarrow \pi^- p$ are given. (auth)

25812 OPTIMAL POSITIVITY BOUNDS TO THE UP–DOWN ASYMMETRY IN ELASTIC ELECTRON–PROTON SCATTERING. De Rujula, A. (Harvard Univ., Cambridge, MS); Kaplan, J. M.; De Rafael, E. Nucl. Phys.; B53: No. 3, 545-566(12 Mar 1973).

New positivity bounds on the up–down asymmetry in elastic electron–proton scattering are derived. The bounds are rigorous to order $\alpha \simeq \frac{1}{137}$, and optimal in the sense that they fully exploit the positivity restrictions of the off-shell absorptive Compton amplitudes which govern the asymmetry effect. The results are compared with existing experiments and discuss their relevance to future ones. (auth)

25813 THRESHOLD PROPERTIES OF ELECTROPRODUCTION AND ANNIHILATION. Landshoff, P. V.; Polkinghorne, J. C. (Cambridge Univ., Eng.). Nucl. Phys.; B53: No. 3, 473-483(12 Mar 1973).

The threshold relation for deep-inelastic electroproduction that was suggested by Drell and Yan and by West is not a general property of softened field theories. However, for individual Feynman graphs of certain perturbation-expansion models it is valid in the form of an inequality. This is shown for every graph in ϕ^3 theory, and for certain simple graphs when fields and particles with spin are considered, provided that the fields to which the electromagnetic current couples have the same spin as the target particle. The structure functions $F_2(\omega)$ and $\bar{F}_2(\omega)$ for electroproduction and electron-positron annihilation are both expected to behave like $|\omega - 1|^p$ at $\omega = 1$, with the same power p for each but not necessarily the same coefficient. The behavior of $\bar{F}_2(\omega)$ at $\omega = 0$ is investigated and is found to result in finite multiplicity in the annihilation process at infinite energy. (auth)

25814 COHERENT PHOTOPRODUCTION OF π^+ FROM ^{3}He. Ezra, D. (University Coll., London). Lett. Nuovo Cim.; 6: No. 9, 317-320(3 Mar 1973).

The differential cross section for the reaction $\gamma + {}^3\text{He} \rightarrow \pi^+ + {}^3\text{H}$ is calculated in the Breit frame using the impulse approximation. The results are compared with calculations in the laboratory frame. (LBS)

25815 DISPERSION SUM RULES FOR STRONG AND ELECTROMAGNETIC INTERACTIONS. Ferro Fontan, C. (CERN, Geneva); Queen, N. M.; Violini, G. Riv. Nuovo Cim.; 2: No. 4, 357-497(1972).

A unified and comprehensive survey of superconvergence relations, finite-energy sum rules, and continuous-moment sum rules and their applications to strong and electromagnetic interactions is presented. (JFP)

25816 SOME REMARKS ON FIXED POLES IN VIRTUAL COMPTON SCATTERING. Tataru-Mihai, P. I. (Univ., Cluj). Lett. Nuovo Cim.; 6: No. 9, 346-350(3 Mar 1973).

The question of fixed poles for the virtual (off-mass-shell) Compton scattering amplitudes and their relevance for the scaling phenomenon is discussed by means of the perturbation approach to the parton model developed by Drell et al. It is concluded that the perturbation parton approach reveals the intimate connection between scaling, light-cone physics and fixed poles in current amplitudes. It does permit the discrimination between the third spectral function and anticommutator J = 1 fixed poles, but suggests a $q^2 = 0$ conspiracy which explains the pomeron coupling in the Compton amplitude. (LBS)

25817 ELECTRON–POSITRON ANNIHILATION INTO FOUR CHARGED PIONS IN THE STATISTICAL BOOTSTRAP MODEL. Rudaz, S. (McGill Univ., Montreal). Lett. Nuovo Cim.; 6: No. 8, 292-296(24 Feb 1973).

Frantschi's statistical bootstrap model is tested by applying it to the annihilation process $e^+e^- \rightarrow \pi^+\pi^-\pi^+\pi^-$. Dominance of a one-photon mechanism is assumed for this reaction. Contributions to the cross section from diagrams for the decay of a fireball into a $\rho\pi$ state (σ_a) and into a 3π state (σ_b) are calculated with kT = 100, 140, and 180 MeV. No conclusive statement is made on the value of kT for which the best fit is obtained, however the fit obtained for σ_a at kT = 140 MeV is found to be encouraging. (LBS)

25818 FINAL STATE INTERACTIONS IN LARGE MOMENTUM TRANSFER INELASTIC ELECTRON–DEUTERON SCATTERING. Smith, R. (Cavendish Lab., Cambridge, Eng.); Wilkin, C. Ann. Phys. (N. Y.); 75: No. 1, 103-131(Jan 1973).

A theory for large-momentum-transfer quasi-elastic electron–deuteron scattering is developed by using a diagrammatic technique, and expressions are derived for those triply and doubly differentiated cross sections which are experimentally measured. The effects of spin are included in an approximate way, and the results are compared with recent experiments when this is possible. The importance of the various corrections is investigated. (13 figures, 2 tables). (auth)

25819 HADRON POLARIZABILITIES AND THE CHARGE OF HADRONIC CONSTITUENTS. Cannata, F. (Univ., Bologna). Lett. Nuovo Cim.; 6: No. 10, 379-380(10 Mar 1973).

Hadron electric-dipole polarizabilities are discussed in the framework of the nonrelativistic symmetric quark model using sum rule techniques. The polarizabilities of the proton and the charged pion are calculated. Implications of the study of hadronic polarizabilities as indirect probes of the fractional hadronic constituents are given. (LBS)

25820 NONPERTURBATIVE EVALUATION OF A LOW-ENERGY THEOREM FOR $\gamma \rightarrow 3\pi$. Nash, C. (Cambridge Univ., Eng.). Lett. Nuovo Cim.; 6: No. 12, 467-469(24 Mar 1973).

It is shown that the low-energy theorem relating the processes $\gamma \rightarrow 3\pi$ and $\pi \rightarrow 2\gamma$ can be calculated exactly without recourse to perturbation theory. (LBS)

25821 PRINCIPLE OF MINIMAL ELECTROMAGNETIC INTERACTION IN TERMS OF PURE GEOMETRY. von Westenholz, C. (Univ., Mainz). Ann. Inst. Henri Poincare, Sec. A; 17: No. 2, 159-170(1972).

A geometric version of the principle of minimal electromagnetic interaction is given. (France)

25822 ABUNDANCE AND LATERAL DISTRIBUTION OF MUONS IN INCLINED SHOWERS. Dardo, M. (Univ., Turin); Briatore, L.; Sitte, K. Nuovo Cim.; 14B: No. 1, 15-31(11 Mar 1973).

It has been argued previously that observations on the muon/electron ratio could provide clues regarding the origin of HAS. This ratio and the muon lateral distribution have been calculated for showers initiated by muon photonuclear interactions, and for showers due to collisions of heavy particles which undergo hadronic interactions with a small cross section and small inelasticity, such as triplet particles. At equal electron shower size the total number of muons present is higher by factors of about 5 to 10 in the triplet mode of origin than in photonuclear showers. But the bulk of these muons is found at large distances from the axis; there is very little difference between the two cases in the muon densities observed near the core. Thus no distinction is possible on the basis of the customary experiments which essentially restrict muon detection to small distances. In principle it could be achieved by an underground experiment, but this seems impracticable because of the low detection rate. The most promising technique appears to be the use of Cherenkov detectors coupled with muon detectors. (auth)

25823 EFFECT OF RAPIDLY RISING PROTON–PROTON TOTAL CROSS SECTIONS ON IDEALIZED EXTENSIVE AIR SHOWERS. Campbell, J. A. (Univ. of Texas, Austin). Aust. J. Phys.; 25: No. 6, 679-684(Dec 1972).

A simulation of extensive air showers above 10^{13} eV in which proton–proton scattering takes place partly through a medium-strong interaction is reported. Previously the simulation has been shown to be in fair agreement with observational data. The present version includes for the first time the assumption that the total cross section for proton–proton scattering increases with energy, as concluded in a recent paper by Yodh, Pal, and Trefil. The effect of the assumption is to make a noticeably better agreement between the simulation and the data. (auth)

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Refer also to abstract 26412.

25824 (IFVE-STF-71-94) PARTICLE DECAY KINEMATICS AT HIGH ENERGIES. Gorina, N. D. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Serpukhov. Institut Fiziki Vysokikh Energii). 1971. 15p. (In Russian). INIS.

The distribution function for the decay products of one particle into two particles with equal masses $A \rightarrow a_1 + a_2$ was derived. The ultrarelativistic case, where the Lorentz factor of the A particle is $\gamma \gg 1$, was examined. The distribution function was obtained in the explicit form. The decay $K^0 \rightarrow \pi^+\pi^-$ was examined as an example. (tr-auth)

25825 (LA-5175-MS) NEUTRINO DISINTEGRATION OF THE DEUTERON AT LAMPF ENERGIES. O'Connell, J. S. (Los Alamos Scientific Lab., N. Mex.). Mar 1973. Contract W-7405-eng-36. 7p. Dep. NTIS $3.00.

The differential cross section for the neutrino disintegration of the deuteron is calculated using effective range theory for neutrino energies from zero to 53 MeV. (auth)

25826 BOUNDS ON THE K_{l3} SCALAR FORM FACTOR FROM LOW ENERGY $K\pi$ PHASE SHIFT. Bourrely, C. (CERN, Geneva). Nucl. Phys., B; B53: No. 2, 289-302(26 Feb 1973).

Upper and lower bounds on the scalar form factor of K_{l3} decay are calculated using the analytic properties of the form factor, the experimental low-energy S-wave $K\pi$ phase shift, and an estimate of the propagator $\Delta(t)$ of the divergence of the strangeness changing current at zero momentum. The condition given by the soft-pion theorem on $f(m^2_K)$ that was considered in a previous work is released. For this reason the new bounds are less restrictive. However they are sufficiently strong to be inconsistent with some experimental data irrespective of the fit used for $K\pi$ scattering. (auth)

25827 SCALING BEHAVIOR IN A QUARK–PARTON MODEL WITH SECOND-CLASS CURRENTS. Kim, B. R.; Rodenberg, R. (Technische Hochschule, Aachen). Nuovo Cim.; 13A: No. 3, 805-812(1 Feb 1973).

A quark–parton model is investigated for neutrino-nucleon scattering including a second-class axial vector current. It is found that in the presence of a second-class axial vector current the structure function W_2 does not scale. Although this result is based on the special form of this second-class current it is conjectured that nonscaling is a characteristic feature of second-class currents. (auth)

25828 QUARK MODEL PREDICTIONS FOR WEAK PRODUCTION OF PSEUDOSCALAR MESONS. Koepp, G. (Technische Hochschule, Aachen). Nuovo Cim.; 13A: No. 3, 793-804(1 Feb 1973).

Applying the quark model to weak production of pseudoscalar mesons, the absence of some reactions is predicted by requiring only nonexotic t-channel exchanges. Further, relationships between several production cross sections based on the additivity assumption of the quark model are derived. (auth)

25829 SECOND-CLASS CURRENT PROBLEM: ROLE OF MESON EXCHANGES. Kubodera, K.; Delorme, J.; Rho, M. (CEN de Saclay, Gif-sur-Yvette, France). J. Phys. (Paris), Colloq.; No. 5, 144(1972).

The role played by meson exchange in β decay processes and weak interactions is discussed. (FR)

25830 GENERALIZED FORM FACTORS FOR PROCESSES OF THE NEUTRINO–HADRON SCATTERING. Rekalo, A. P. (Physical-Technical Inst., Kharkov). Ukr. Fiz. Zh. (Russ. Ed.); 18: No. 1, 13-17(Jan 1973). (In Russian).

The processes of the neutrino-hadron scattering (elastic and

inelastic) are considered. Irrespective of the initial state hadron spin, the hadron vertex contribution to the observed values averaged by polarizations of the initial hadron and summed by all the final hadron states is described by 6 generalized form factors taking into account the current nonconservation and violation of the P-invariance. It is shown that measuring of the differential cross section and polarization of the final lepton is necessary to determine all 6 generalized form factors. (auth)

25831 SPIN-DEPENDENT SUM RULE FOR HIGH-ENERGY NEUTRINO REACTIONS. Lane, K.; Suzuki, M. (Univ. of California, Berkeley). Phys. Lett.; 43B: No. 3, 204-206(5 Feb 1973).

We present a sum rule which related the inclusive cross sections for high energy neutrino scattering on polarized proton targets to the axial-vector coupling constant. The derivation of the sum rule rests on the equal-time algebra of the time-components of the weak currents. The sum rule also provides a discriminatory test of unified models of weak and electromagnetic interactions based on spontaneously broken gauge symmetry. (auth)

25832 CHIRAL-LIMIT THEOREMS AND CORRECTIONS TO PCAC IN A MODEL FOR THE SCALAR K_{l3} DIVERGENCE FORM FACTOR. Wambach, U. M. (Ruhr Univ., Bochum, Ger.). Nucl. Phys.; B53: No. 3, 597-612(12 Mar 1973).

Three sum rules on vertex functions are derived by applying a model on two-particle $K\pi$ channels. SU(3) × SU(3) breaking is introduced by corrections to the PCAC forms of the axial currents. Taking the $m_\pi \to 0$ limit the sum rules reduce to the Callan–Treiman theorem, a recent theorem by Dashen, Li, Pagels, and Weinstein (DLPW) and a third relation. Non-analytic correction terms are encountered in the two first sum rules. In the DLPW theorem, contrary to the previous suggestion, non-negligible ϵ and $\epsilon^2 \ln \epsilon$ terms are found which are due to the large K-mass. These terms are responsible for a curvature of the scalar K_{l3} form factor, however negative values of the slope at the origin require also substantial SU(2) × SU(2) violations. The numerical results taking into account physical masses compare favorably with K_{l3} decay and also with s-wave $K\pi$ scattering data. (auth)

25833 OVERALL COUPLING CONSTANT RENORMALIZATION IN WEINBERG'S MODEL. Bailin, D. (Univ. of Sussex, Brighton, Eng.). Nuovo Cim.; 14A: No. 1, 199-206(1 Mar 1973).

It is demonstrated by explicit calculations that the lowest-order divergent contributions to the overall semi-weak coupling constant renormalization arising from the proper vertex parts and the field operator renormalization are independent of the mass of the lepton. (auth)

25834 POSSIBLE COMPOSITE LEPTON STATES INDUCED BY NEUTRINOS. Budini, P. (International Centre for Theoretical Physics, Trieste, Italy); Furlan, P. Nuovo Cim. A; 13A: No. 4, 937-975(21 Feb 1973).

Starting from the weak diagonal lepton Lagrangian, a Bethe–Salpeter equation for the study of lepton bound states is set up. It is shown on general grounds that for a V–A current-current Lagrangian the free-lepton–bound-state vertex can only have the form $\Gamma = \gamma^\mu(1+\gamma_5)A_\mu$. The kernel for a ladder approximation, corresponding to neutrino loop exchange, obeys a gauge condition and is only logarithmically divergent; it corresponds to a r^{-6} dependent force which is attractive for leptons-antileptons. A gauge-invariant technique of regularization of the kernel is given. The equations for the bound states have decoupled sectors. In particular, the equations for massless vector bound states having the quantum number of the photon are given. It is shown that in the Konopinski theory of leptons the muon would give a vertex $\Gamma = \gamma^\mu(1-\gamma_5)A_\mu$ and a model is presented by which a combination of electron-muon leptons could give rise to an effective electrodynamic Lagrangian for leptons. In such a model, lepton quantum electrodynamics would be finite; considering that in order to obtain massless vector composite states a regularization with masses of the order of $G_F^{-1/4}$ is necessary, the standard local theory should keep its validity up to distances of the order of $G_F^{1/4}$. (auth)

25835 NEUTRINO AND ANTINEUTRINO TOTAL CROSS SECTIONS IN THE QUARK PARTON MODEL. II. Gourdin, M. (Laboratoire de Physique Theorique et Particules Elementaires, Orsay, France). Nucl. Phys., B; B53: No. 3, 509-520(12 Mar 1973).

The consequences of recent measurements of total cross sections for neutrino and antineutrino induced reactions for a quark parton model description of inelastic lepton-nucleon deep inelastic scattering are investigated. (auth)

25836 APPLICATION OF THE IVB THEORY TO SEVERAL NEUTRINO PROCESSES OF ASTROPHYSICAL IMPORTANCE. Abak, M. (Univ., Kiel). Fortschr. Phys.; 19: No. 8, 529-557 (1971). (In German).

A survey is given of the application of the intermediate vector boson theory of weak interactions to several neutrino processes of astrophysical significance. Under the assumption of the existence of charged intermediate vector bosons (W-meson), the reaction cross sections for the processes $\gamma + \gamma \to \gamma + \nu + \bar{\nu}$ (photon-photon-photon), $\gamma + \gamma \to \nu + \bar{\nu}$ (photon-photon), $e^- + e^+ \to \nu + \bar{\nu}$ (electron-positron pair annihilation) and $e + \gamma \to e + \nu + \bar{\nu}$ (photo-neutrino) are calculated in the low-energy approximation according to the method of T. D. Lee and C. N. Yang. Further, the possible effect of these processes on the energy loss in star formation is studied. The result of this work is compared with results of current-current interactions and photon-neutrino interactions obtained by other authors. Finally, some consequences of the assumption of charged intermediate W-meson for astrophysics and cosmology are discussed. (tr-auth)

25837 WEAK INTERACTION HAMILTONIANS. Pietschmann, H. (Univ., Vienna). pp 1-27 of Symposium on Nucleons and Weak Interactions. Eman, B. (ed.). Zagreb; Institute Rudjer Boskovic (1971).

From Symposium on nucleons and weak interactions; Zagreb, Yugoslavia (Jul 1971). See CONF-710737-.

A review is given of weak interactions deduced from semi-leptonic and nonleptonic processes emphasizing the role of hadronic currents. The interaction Hamiltonian and the baryonic and mesonic matrix elements of the hadronic current are discussed. (JFP)

25838 RADIATIVE CORRECTIONS TO NON-LEPTONIC KAON DECAY AND SUPERWEAK INTERACTION. Kim, D. Y. (International Centre for Theoretical Physics, Trieste, Italy); de la Cruz, V. pp 315-326 of Symposium on Nucleons and Weak Interactions. Eman, B. (ed.). Zagreb; Institute Rudjer Boskovic (1971).

From Symposium on nucleons and weak interactions; Zagreb, Yugoslavia (Jul 1971). See CONF-710737-.

The magnitude of the effect of radiative corrections of $K_1^0 \to \pi^+ + \pi^-$ decay is treated. (JFP)

25839 SOME ASTROPHYSICAL IMPLICATIONS OF SECOND-ORDER EFFECTS IN THE V–A THEORY OF WEAK INTERACTIONS. Lopez-Cepero, A. B.; Maiella, G. (Univ. of Texas, Austin). Contract AT(40-1)-3992. Lett. Nuovo Cim.; 14A: No. 2, 245-268(21 Mar 1973).

The astrophysical implications of a previous attempt to evaluate the second (and higher)-order terms in the V–A current-current theory are considered. The pair annihilation process is analyzed in detail; then it has been found to which extent the second-order terms contribute in the presence of first-order effects. Also a treatment of the second-order contributions has been made in the case of absence of the first-order process $(e\nu_e) \to (\nu_e e)$, i.e., absence of the diagonal interaction. Furthermore other processes are briefly discussed in respect of the relevance of second-order terms. The physical situations in which second-order terms may give observable effects are indicated, while the hypothesis of absence of the diagonal interaction is found in contradiction with the observations. (auth)

25840 DETERMINATION OF MIXING ANGLE IN WEINBERG'S $SU_2 \times U_1$ MODEL. Acharya, R.; Horvath, Z. (Dublin Inst. for Advanced Studies). Lett. Nuovo Cim.; 6: No. 12, 464-466(24 Mar 1973).

It is shown that the mixing angle can be determined within the original SU(2) × U(1) framework by imposing the notion of asymptotic symmetry. Two solutions are found. (LBS)

25841 VIRTUAL NEUTRINO EFFECTS. Budini, P. (International Centre for Theoretical Physics, Trieste, Italy). Fizika (Zagreb); 4: No. 4, 223-233(Dec 1972).

It is shown that the attractive forces due to exchange of neutrino pairs between leptons and antileptons are of such a nature that, if their long-range x^{-6} behavior continues up to distances of the order $G_F^{1/4}$, they are apt to give massless composite lepton–antilepton states. These states could only have spin-one and they would presumably be medium strongly bound to free leptons. Possible consequences are discussed. (auth)

25842 POSSIBLE UNIVERSAL NEUTRINO INTERACTION. Volkov, D. V.; Akulov, V. P. (Physical-Technical Inst., Kharkov). JETP Lett. (USSR) (Engl. Transl.); 16: No. 11, 438-440(5 Dec 1972).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 16: No. 11, 621-624(5 Dec 1972).

It is pointed out that the hypothesis that the neutrino is a Goldstone particle leads to a definite type of neutrino interaction both with other neutrinos and with all other particles. The interaction is fully defined by a single phenomenological coupling constant and is in this sense universal. (LBS)

Strong (General)

25843 (COO-3533-7) ρ DOMINANCE AND REGGE COUPLINGS IN INCLUSIVE REACTIONS. Amann, R. F.; Blackmon, M. L. (Syracuse Univ., N. Y. Dept. of Physics). Nov 1972. 17p. (SU-4205-7). Dep. NTIS $3.00.

The ρ Regge pole residues are calculated under the assumption of ρ dominance of the isovector, even G parity component of inclusive reactions. The calculated residues compare well with total cross section data and allow successful predictions of the charge dependence of pion production in the central region. Serious difficulties are encountered with the assumption of P + f dominance of the isoscalar, even G parity component. (auth)

25844 (IFPTH-9/72) MODELS FOR HIGH ENERGY PRODUCTION PROCESSES. A CRITICAL DISCUSSION. Bassetto, A. (Padua Univ. (Italy). Istituto di Fisica; Istituto Nazionale di Fisica Nucleare, Padua (Italy)). Dec 1972. 10p. (CONF-721140-1). Dep. NTIS (U. S. Sales Only).

From fifty-eighth meeting of the Italian Physical Society; Cagliari, Italy (Nov 1972).

Models for high energy production processes in strong interactions are discussed. These models are divided into two classes, that in which the limitation is explicitly imposed, and that in which the limitation is a deep consequence of a bootstrap hypothesis. (JFP)

25845 (JINR-E2-6918) MULTIPLICITY DISTRIBUTION OF PARTICLES PRODUCED IN VERY HIGH ENERGY HADRONIC COLLISIONS. Koba, Z. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 38p. (CONF-721079-1). Dep. NTIS (U. S. Sales Only) $4.00.

The works on inclusive hadron-hadron collisions at very high energy are reviewed and the newest data on experimental and theoretical studies in this field are given. The following problems are considered: the main features of high energy collisions, topological cross sections, scale invariance. (auth)

25846 (JINR-P2-6910) STRONG COUPLING THEORY FOR A MODEL OF NONRELATIVISTIC PARTICLES INTERACTING WITH THE SCALAR NEUTRAL MESON FIELD. Zastavenko, L. G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 25p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.25.

A model of nonrelativistic particles, interacting with the scalar neutral meson field, is considered. For the bound state problem of a great number of n particles the parameter of strong coupling expansion is shown to be not g^{-1}, but $(gn)^{-1}$. It follows that, however small the value g is, for a system with sufficiently great number of n particles the case of strong coupling will take place and the bound states of a system of n particles will exist. (auth)

25847 RESONANCE PRODUCTION AND INCLUSIVE CROSS SECTIONS IN DUAL MODELS. Masperi, L.; Rebbi, C. (CERN Geneva). Nuovo Cim.; 13A: No. 3, 689-707(1 Feb 1973).

The contribution to inclusive spectra of produced intermediate resonances is numerically computed through the discontinuity of one-loop dual amplitudes. These contributions are found to be smaller but not negligible as compared to those coming from tree graphs. Scaling may be reached for loop diagrams at higher energies than trees. The cut-off in transverse momentum is preserved even for rather heavy intermediate produced resonances. It is argued that this fact is related with strong polarization effects in the decay of resonances in the dual model. (auth)

25848 INCLUSIVE TWO-PARTICLE CORRELATION FUNCTION AND MULTIPLICITY DISTRIBUTION IN AN UNCORRELATED JET MODEL WITH TWO LEADING PARTICLES. Sohlo, S. (NORDITA, Copenhagen). Nucl. Phys., B; B53: No. R366-394, 410-418(26 Feb 1973).

The effect of leading particles and energy-momentum conservation on the inclusive two-particle correlation function and multiplicity distribution is considered in uncorrelated jet models. A two-component model is suggested, in which Feynman's scaling is broken in one component. (auth)

25849 SEMI-GROUP APPROACH TO MULTIPERIPHERAL DYNAMICS. Ferrara, S. (CNEN, Frascati, Italy); Mattioli, G.; Toller, M. Nucl. Phys., B; B53: No. R366-394, 366-394(26 Feb 1973).

The multiperipheral integral equation at vanishing four-momentum transfer in the form given by Chew and da Tar is considered and it is remarked that the angular integrations can be interpreted as a convolution of measures defined in a semigroup S contained in the Lorentz group. The geometrical properties and a class of Banach-space representations of this semigroup are studied. By projection on these representations, a partial wave analysis of the multiperipheral equation is performed. Under some physically very natural conditions, it is proved that the projection integrals converge, the partial wave amplitudes are analytic in a half-plane of the complex angular momentum and the kernel of the partial wave equation represents a bounded operator. A preliminary discussion of the inversion problem, i.e., of the construction of the amplitude from its partial wave projections, is given. (auth)

25850 CHIRAL DYNAMICS AS ZERO-SLOPE LIMIT OF THE DUAL PION MODEL. Kawarabayashi, K.; Kitakado, S. (Tokyo Univ.). Nuovo Cim.; 14A: No. 1, 190-198(1 Mar 1973).

It is shown that in taking a particular zero-slope limit ($\alpha' \to 0$, $m_\frac{1}{2}^2$ = finite), the dual pion model reduces to a nonlinear σ-model with $(\frac{1}{2},\frac{1}{2})$ symmetry breaking in the tree approximation. (auth)

25851 INTEGRAL EQUATIONS FOR THE CHAIN DECAY OF FIREBALLS. Montvay, I. (CERN, Geneva). Nucl. Phys., B; B53: No. 3, 521-544(12 Mar 1973).

Integral equations for the chain decay of fireballs are derived in the thermodynamic model. The single-particle distribution and multiplicity distribution of the decay products are considered. The asymptotic solutions are given explicitly and the deviation from them for finite fireball mass is determined numerically. (auth)

25852 SIXTEENTH INTERNATIONAL CONFERENCE ON HIGH ENERGY PHYSICS. 2. High Energy Strong Interactions. Low, F. E. (Massachusetts Inst. of Tech., Cambridge). Comments Nucl. Particle Phys.; 5: No. 4, 119-123(Jul 1972).

Comments are offered on work reported in the field of high energy strong interactions at the Sixteenth International Conference on High Energy Physics, University of Chicago, September 1972. It is stated that at a deep level there is very little understanding of the hadronic world. At the phenomenological level data may, however, be organized in terms of particle states, many of whose properties can be predicted by a quark model, and whose nondiffractive interactions can be understood in terms of exchanges of the Regge trajectories on which these states lie. Diffraction scattering and diffractive reactions, however, do not appear to fit into this description in a natural way. The studies are reported under the following headings: factorization; fragmentation; pionization; the Ferbel point; shrinkage and shape of the diffraction peak; and wide angle phenomena. (UK)

25853 INCLUSIVE REACTIONS: MODELS OF MULTI-PARTICLE PRODUCTION. Ranft, G.; Ranft, J. (Karl-Marx-Univ., Leipzig). Fortschr. Phys.; 19: No. 7, 393-450(1971).

Model independent predictions such as Feynman scaling and the hypothesis of limiting fragmentation (HLF) for multi-particle production are reviewed. The thermodynamic model and the multi-Regge model and their description of inclusive spectra are outlined and the connection of both models is discussed with special emphasis on the predictions of these models fulfilling Feynman scaling and HLF. Various possibilities for data presentation are discussed as well as tests are proposed to distinguish between different models. (auth)

25854 DYNAMICAL AVERAGES IN THE DUAL-RESONANCE MODEL. Gorenstein, M. I.; Miranskii, V. A.; Shelest, V. P.; Struminskii, B. V.; Zinoviev, G. M. (Inst. for Theoretical Physics, Kiev). Lett. Nuovo Cim.; 6: No. 9, 325-328(3 Mar 1973).

The method of dynamic averages is proposed for the statistical treatment of dual resonance models. The important role of the dynamic averages is shown by calculating the averages of the operator of the angular-momentum projection and the resonance decay width operator. (LBS)

25855 MANY-PARTICLE INCLUSIVE CROSS-SECTIONS AND CORRELATIONS IN HADRONIC PRODUCTION PROCESSES AT VERY HIGH ENERGY. Koba, Z. (Univ. of Copenhagen). Acta Phys. Pol.; B4: No. 1, 95-143(1973).

Theoretical studies on many-particle inclusive cross sections and correlations in hadronic collision are reviewed. General properties of cross sections and correlations, fluid analogy, kinematical constraints (sum rules), coexistence of two mechanisms, and asymptotic predictions of correlations in various models are discussed. (auth)

25856 PRODUCTION OF MESONS WITH ANY SPINS. Demchenko, G. P. (Inst. for Theoretical Physics, Kiev). Lett. Nuovo Cim.; 6: No. 8, 297-301(24 Feb 1973).

A method for calculation of the production cross section of resonances with high masses and spins using the statistical features of the dual-resonance models is proposed. The process of a deep inelastic collision of two hadrons a and b which result in the production of the muon pair of some hadron system X, according to the process $a + b \to \mu^+ + \mu^- + X$, is considered. The mass spectrum of the di-muon is calculated as an example. (LBS)

25857 T-CHANNEL HELICITY CONSERVATION IN DIFFRACTIVE PRODUCTION PROCESSES. Vanryckeghem, L. G. F. (Univ. of Cape Town). Lett. Nuovo Cim.; 6: No. 12, 479-481(24 Mar 1973).

It is shown that t-channel helicity can be conserved in diffractive processes when the dominant contribution to the amplitude factorizes into a vertex containing the resonance and a vertex containing the spectator particle without any correlations between them. (LBS)

25858 ANALYSIS OF WEINBERG'S ALGEBRAIC RELATIONS. Noga, M.; Prokes, J. (Komensky Univ., Bratislava). Czech. J. Phys.; 23: No. 1, 19-24(1973).

Implications of Weinberg's algebraic relations when only p-wave pions are taken into account are investigated. It is shown that decay rates and mass spectra of hadrons assigned to certain classes of unitary irreducible representations of the SU(4) group are in a strong disagreement with experimental data. (auth)

Strong (Baryon No. = 0)

25859 (DESY-72/74) PION SELF-ENERGY EFFECTS IN THE ρ MESON FROM THE WARD IDENTITY. Gutbrod, F. (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). Dec 1972. 22p. Dep. NTIS (U. S. Sales Only) $3.25.

A previously proposed Bethe-Salpeter model for $\pi\pi$ P-wave scattering containing a nucleon loop as force is improved in two respects: First of all the connection between the electromagnetic pion vertex and the pion propagator given by the Ward identity is used to renormalize the propagator. Secondly the influence of the $\pi\omega$-channel via its strongly energy dependent coupling to the $\pi\pi$ channel on the ρ-width is investigated. The results show that the propagator corrections have very strong influence, and reasonable assumptions on the $\omega N\bar{N}$ coupling constant lead to a ρ-width of 200 MeV. (auth)

25860 (FRNC-TH-288) STUDY OF ANTIPROTON-PROTON ANNIHILATION AT INTERMEDIATE ENERGIES. Rivoal, M. 1971. 93p. (In French). Dep. NTIS (U. S. Sales Only).

Thesis.

Antiproton-proton annihilation at 2.5 GeV/c was studied. The production cross sections for resonances such as K*, ρ, and ω in the $K\bar{K}n\pi$(n = 1, 2, 3) channels were calculated. Particular attention was given to the analysis of the $K^0\bar{K}^0K^+K^-$ final state, the interest in this state arising from the possibility it provides for studying an exotic KK channel having a strangeness of 2. The results are compared to those obtained using the Fermi statistical model modified by the introduction of strong interaction invariance in relation to the SU(3) group. Generally the agreement is good. Studies of the antiproton $K^0_1K^{\pm}\pi^{\mp}$ reaction were effected using the Veneziano model. (auth)

25861 FORWARD DISPERSION RELATIONS FOR $\pi^-\pi^0$ SCATTERING. Laurens, G. (CEN, Saclay, France). Nuovo Cim.; 14A: No. 1, 161-168(1 Mar 1973).

Some results concerning the evaluation of a dispersion relation for the elastic $\pi^-\pi^0$ scattering amplitude are given. The consistency in the low-energy region between input and output phase shifts leads to a scattering length of -0.055 ± 0.15 for the I = 2 S-wave phase shift. Analytic representations for the I = 1 P-wave and I = 2 S-wave are given together with the experimental points. (auth)

25862 SU_3 MESON MASS FORMULAS IN A RELATIVISTIC SCALAR QUARK MODEL. Becher, P.; Boehm, M. (Univ., Wuerzburg, Ger.). Nuovo Cim.; 13A: No. 3, 708-714(1 Feb 1973).

Quadratic meson mass formulas are derived in the framework of a relativistic scalar quark model. For all excitations, the same mass difference between the isodoublet and isotriplet states and an ideal mixing of the isosinglets is predicted. (auth)

25863 DUAL GEOMETRICAL MODEL WITH CROSSING SYMMETRY. Hosoya, A.; Tokuda, N. (Tokyo Univ.). Nuovo Cim.; 13A: No. 3, 813-825(1 Feb 1973).

A model of crossing-symmetric, dual geometrical amplitude is constructed, which has poles corresponding to resonances and shows the geometrical structure as well as the Regge behavior at high energy. It is applied to the process $A_1\pi \to \pi\pi$. (auth)

25864 ANALYTIC $\pi\pi$ DUAL AMPLITUDE. Taha, M. O.; Tahir, A. (Univ. of Khartoum, Sudan). Nuovo Cim.; 13A: No. 3, 379-688(1 Feb 1973).

A $\pi\pi$ dual amplitude of the modified CHKZ type is introduced and investigated. It reduces to the Lovelace-Veneziano model in the narrow-resonance limit. The amplitude is found to satisfy the Breit-Wigner resonance form at both the ρ and f resonances, predicting a mass relation which is reasonably satisfied experimentally. The Breit-Wigner form test fails at the g-resonance. (auth)

25865 STUDY OF THE CONDITIONS SET BY UNITARITY AND TIME-REVERSAL INVARIANCE IN THE $\rho-\omega$ MIXING WITH THE THREE-BODY MIXING FORMALISM. Gien, T. T. (Memorial Univ. of Newfoundland, St. John's). Can. J. Phys., 50: No. 24, 3198-3205(15 Dec 1972).

Using the recently developed three-body interference formalisms the conditions imposed by time-reversal invariance and unitarity on the relative phase and strength of the $\rho-\omega$ mixing in the presence of vector meson ϕ are studied. It is found that the effect of vector meson ϕ on these conditions when they are compared to those obtained with the usual two-body interference formalisms is very small. Even if the width of ϕ was ten times larger than the actual one, still this effect would be negligible. Thus, this detailed analysis confirms again the possibility of neglecting the effect of ϕ in the $\rho-\omega$ mixing problem. All the conclusions reached in this study are based purely on the experimental data alone and thereby independent of the detailed dynamical assumptions on the decays of ρ, ω, and ϕ. We also wish to point out that an upper bound for the $\rho-\omega$ mixing strength in the 2π decay mode can be obtained from the knowledge of the masses and partial decay rates of channels other than 2π of ρ and ω. (auth)

25866 STRAIGHTNESS OF BOSON TRAJECTORIES. Peaslee, D. C. (Massachusetts Inst. of Tech., Cambridge). Lett. Nuovo Cim.; 6: No. 8, 283-286(24 Feb 1973).

Divergent linear trajectories and parallel linear trajectories for boson resonances are obtained from assignments of L and J values according to the quark or fermion-antifermion model. (LBS)

25867 RADIAL EFFECTS IN THE SYMMETRIC QUARK MODEL. De, T.; Kim, Y. S.; Noz, M. E. (Univ. of Maryland, College Park). Nuovo Cim. A; 13A: No. 4, 1089-1101(21 Feb 1973).

Effects of the radial wave function are studied for the nonstrange baryons in the symmetric quark model. Rotational energy levels are calculated and are found to be in agreement with the energy levels in the observed baryonic mass spectra. Relativistic perturbative effects which vanish in the large-quark-mass limit are also calculated. The lower bound on the quark mass is found to be approximately 1.5 GeV. (auth)

25868 PHYSICAL FOUNDATIONS OF NONRELATIVISTIC QUARK MODELS: BOSONIC SPECTRUM AND REGGE TRAJECTORIES. Pisent, G.; Pusterla, M. (Univ., Padua). Nuovo Cim. A; 13A: No. 4, 845-866(21 Feb 1973).

The bosonic spectrum and the Regge trajectories related with two specific nonrelativistic models (volume and surface models) for the quark-antiquark system are computed in detail. A connection between the model that gives the best predictions and a more fundamental field theory for the quarks is also considered and discussed. Within the framework of the SU_3 symmetry the scalar or pseudoscalar field theories are favored by our analysis in comparison with the vector one. (auth)

25869 UPPER BOUNDS FOR THE ASYMPTOTIC BEHAVIOR OF REGGE TRAJECTORIES. Fleming, H.; Montes Filho, A. (Univ., Sao Paulo, Brazil). Nuovo Cim.; 14A: No. 1, 215-223 (1 Mar 1973).

Assuming the usual analyticity for mesonic Regge trajectories the asymptotic (power) behavior of the trajectories is correlated with the number of complex zeros of the function $\alpha(s) - N$, N being an integer of adequate parity. Trajectories that grow nearly linearly do not have such zeros. (auth)

25870 $\pi\pi$ SCATTERING AMPLITUDES THAT SATISFY INELASTIC UNITARITY CONSTRAINTS. Kupsch, J. (Univ., Heidelberg). Fortschr. Phys.; 19: No. 11, 783-813(1971).

Amplitudes are constructed which are represented by a Mandelstam representation with a finite number of subtractions and that satisfy $\pi\pi$ crossing symmetry and the unitarity constraints Im $f^I_l(s) \geq |f^I_l(s)|^2$, l = 0, 1, 2, ..., for all energies above threshold $s > 4$, in the three isospin channels I = 0, 1, 2. The following types of solutions are derived. 1) The amplitudes have a positive double spectral function $\rho(s,t) \geq 0$. The total cross section decreases like $\sigma_T(s) \sim (\log s)^{-\delta}$ for arbitrary $\delta \geq 1$, including the limiting case $\delta = 1$. 2) The amplitudes are dominated by Regge poles, the total cross section can reach a constant asymptotic value, $\sigma_T(s) \to$ const. 3) The amplitudes are dominated by Regge cuts, the total cross section can increase logarithmically $\sigma_T(s) \sim \log s$. (auth)

25871 CROSSING AND EXPERIMENTAL $\pi\pi$ S AND P WAVES. Le Guillou, J. C. (College de France, Paris); Basdevant, J. L. Ann. Inst. Henri Poincare, Sect. A; 17: No. 3, 221-226(1972).

The crossing properties of fits to the experimental s and p wave $\pi\pi$ phase shifts of Baton et al. were tested using the equations of

Roy obtained from fixed t dispersion relations. A sum rule for the scattering lengths a_0 and a_2 in which the asymptotic contribution is an important ingredient is also used. The method is accurate and useful. If strict observance of the Baton δ_0^2 is assumed, the lengths disagree with Weinberg's predictions although a_0 agrees with recent Ke^4 indications. If δ_0^2 is less than the Baton value a satisfactory agreement with the Weinberg prediction can be obtained. (France)

25872 PERTURBATION THEORY IN THE DILATON MODEL. Bace, Marjan (Inst. for Theoretical Physics, Utrecht). Phys. Lett.; 43B: No. 3, 222-224(5 Feb 1973).

It is shown that the $\ln \epsilon$ factors, found by Li and Pagels in perturbative expansions in ϵ around spontaneously broken chiral symmetry limits, become factors of ϵ^{-1} in the dilaton model. The method also furnishes an improved derivation of the Li-Pagels result. (auth)

25873 INCLUSIVE K/π PRODUCTION RATIO IN THE CENTRAL REGIONS. Yazaki, S. (Tokyo Univ.). Phys. Lett.; 43B: No. 3, 225-227(5 Feb 1973).

The inclusive K/π production ratio in the central region is studied on the generalized f,f'-coupled Pomeron model. When compared with recent ISR experiments, it is in good agreement with our prediction. The experimental indication for the π/p ratio is also discussed. (auth)

25874 PION PRODUCTION IN HIGH ENERGY PROTON–ANTIPROTON ANNIHILATION. Jacob, M. (CERN, Geneva); Nussinov, S. Nuovo Cim. 14A: No. 2, 335-342(21 Mar 1973).

A simple annihilation model leads to a set of predictions for pion distributions with marked differences with those found in proton-proton collisions. In particular most pions should be produced with low (<2) centre-of-mass rapidity and their mean multiplicity should increase proportionally to the centre-of-mass energy. (auth)

25875 RADIATIVE DECAYS OF MESONS AND AN EXTENDED VECTOR-MESON DOMINANCE MODEL. Bramon, A.; Greco, M. (CNEN, Frascati, Italy). Nuovo Cim. 14A: No. 2, 323-334 (21 Mar 1973).

A model describing the radiative $P \to \gamma\gamma$, $V \to P\gamma$, $P \to PP\gamma$ and the strong $V \to PPP$ decays is proposed. The amplitudes for processes with a three-particle final state are approximated by finite dispersion relations and the coupling constants are related by the quark model. Predictions derived from usual VMD are only in qualitative agreement with experiments. Better agreement is achieved by extending VMD with the inclusion of further vector mesons. (auth)

25876 HIGH ENERGY NUCLEON–NUCLEON CHARGE EXCHANGE SCATTERING IN A WEAK-CUT MODEL. Manesis, E. K. (Univ. of Chicago). Nuovo Cim.; 14A: No. 2, 269-284 (21 Mar 1973).

Including a high-lying isoscalar pole trajectory X (closely related to the fixed-pole pomeron) in an absorption model with exchange-degenerate ρ and A_2 poles, differential cross sections and polarizations at $-t \gtrsim 0.2$ GeV/c^2 for np and $\bar{p}p$ charge exchange reactions are computed. Functional forms, trajectories and relative sizes of the ρ residues are taken from previous work by Arnold, Blackmon and Goldstein. The strength of the pomeron and X residue is estimated from high-energy pp elastic scattering data. The sign, magnitude and general shape of the $np \to pn$ polarization found are reasonable in light of the available data. The predicted $\bar{p}p \to \bar{n}n$ differential cross section, at least for $-t \gtrsim 0.2$ GeV/c^2, is in reasonable agreement with experiment when the model is fitted only to $pn \to np$. (auth)

Strong (Baryon No. = 1)

Refer also to abstract 25765.

25877 (COO-3533-8) PARTICLE PRODUCTION IN ANNIHILATION PROCESSES. II. Hypercharge. Amann, R. F.; Shah, P. M. (Syracuse Univ., N. Y. Dept. of Physics). Nov 1972. 20p. (SU-4205-8). Dep. NTIS $3.00.

The hypercharge annihilation reaction $K^-p \to \Lambda$ + pions is investigated within the framework of the multiperipheral model. The derivation of scaling predictions and sum rules for this semi-inclusive process is discussed. A simple multiperipheral model with two free parameters is developed and shown to be in good agreement with the measured Λ momentum spectrum and charged prong branching ratios. This model is utilized to predict the as yet unmeasured π^+ momentum spectra for the reaction $K^-p \to \pi^+ + \Lambda$ + pions. (auth)

25878 (FRNC-TH-293) CONSTRUCTION OF SCATTERING AMPLITUDES FROM THE ANALYTICITY AND EXPERIMENTAL DATA. Fernandez Alvarez-Estrada, R. 1971. 104p. (In French). Dep. NTIS (U. S. Sales Only).

Thesis.

The term module representations is used to designate analytical representations giving the phase of an analytic function from its complex zeros and its module along the real axis. These representations are used to predict the scattering amplitudes in a given direction (not the forward direction) in a unique and complete manner for high energies. The problems examined concern; the existence of infinite nonphysical regions and the calculations of their contributions, the determination of the complex zeros, the case of particles with spin, the superconvergent sum rules implied by the superconvergent module representations, and the introduction of unitarity. These methods are applied to study elastic πN scattering. A generalization is made to the nucleon–nucleon scattering case. The Stieljes integrals are introduced. These integrals lead to solutions which enable nonrelativistic scattering amplitudes to be constructed from the differential and total cross sections measured with an infinite accuracy. (France)

25879 (ITF-72-180-E) CONTRIBUTION OF THE T-CHANNEL TO THE CHARGE-EXCHANGE PION–NUCLEON BACKWARD SCATTERING. Lendel, A. I.; Lend'el, V. I. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1972. 16p. Dep. NTIS (U. S. Sales Only) $3.00.

The differential cross section of $\pi^-p - \pi^0n$ backward scattering in lab. momentum region $P_L \sim 2$ to 5 GeV/c is described together with the data on $\pi^\pm p$-processes within the framework of a dual model in which the imaginary part is calculated via backward dispersion relation. The calculations are carried out on electronic computer by minimizing χ^2. Good description of all three pionic processes is obtained. (auth)

25880 EFFECTIVE TEMPERATURE OF RESONANCE DECAY IN THE STATISTICAL BOOTSTRAP MODEL. Frautschi, S. C. (CERN, Geneva); Hamer, C. J. Nuovo Cim.; 13A: No. 3, 645-662(1 Feb 1973).

The energy spectrum of pions emitted in the decay of a heavy resonance with mass m is calculated in the statistical bootstrap model, and compared with the Boltzmann form $p^2 \exp[-E/kT_{eff}]$ to determine an effective temperature. The calculated T_{eff} is near Hagedorn's limiting temperature T_0, but lies (15 to 25)% higher at low E and varies somewhat with energy as E approaches its kinematic limit m/2. These deviations from T_0 result from working with phase space rather than the canonical ensemble, and from following through the full decay chain of the heavy resonance. Consequences for the shape of the transverse-momentum spectrum in inclusive reactions and for the deduction of T_0 from that spectrum are discussed. (auth)

25881 HYPERCHARGE AND ISOTOPIC-SPIN CONSERVATION CONSTRAINTS ON SOME INCLUSIVE REACTIONS. Curiale, J. S. (Univ. of Nijmegen, Netherlands). Nuovo Cim.; 13A: No. 3, 787-792(1 Feb 1973).

The conservation of hypercharge and isotopic spin is used in the approximation of a world whose only stable hadrons are the octets of baryons, antibaryons and pseudoscalar mesons to obtain upper and lower bounds on the average multiplicities of all nonisosinglet neutral stable hadrons in pp, K^+p and π^+p collisions. The validity of the approximation is discussed. (auth)

25882 SOME REMARKS ON POLARIZATION MEASUREMENT AND POLARIZATION DOMAIN. Daumens, M. (Univ., Bordeaux); Massas, G.; Minnaert, P.; Michiel, L. Nucl. Phys., B; B53: No. 2, 303-312(26 Feb 1973).

It is emphasized that any analysis of polarization measurement must be done in terms of the polarization domain which is much smaller than the domain of physical bounds. A possible quantitative procedure is proposed to estimate the precision of a measurement and its compatibility with the positivity condition. The discussion is illustrated with the case of spin-$\frac{3}{2}$ particles and as an application some experimental results on $Y^*(1385)$ are studied. (auth)

25883 TEST OF SOME FACTORIZATION PROPERTIES FROM THE COMPARISON OF THE REACTIONS $\pi^+p \to \pi^+\pi^+\pi^-\pi^0p$ AND $\pi^+p \to \pi^+\pi^+\pi^-\pi^+n$ AT 11.5 GeV/c. Evans, D. (Univ. of Durham, Eng.); Neat, K. P.; Tomasini, G.; Bassler, G.; Nagel, H.; Schilling, P.; Schlatter, W. D.; Borzatta, P.; Cecchet, G.; Costa, G.; Liotta, L.; Ratti, S.; Daudin, A.; Faccini, M. L.; Jabiol, M. A. Nuovo Cim.; 13A: No. 4, 1102-1118(21 Feb 1973).

The reactions $\pi^+p \to \pi^+\pi^+\pi^-\pi^0p$ and $\pi^+\bar{p} \to \pi^+\pi^+\pi^+\pi^-n$ at 11.5 GeV/c are analysed with the aid of LPS plots. The results give a good test on factorization properties of the production amplitude for many-body processes at high energy. The cross section for

such a process factorized as $|f_A(A)|^2 |f_B(B)|^2 |f(\alpha)|^2$ is assumed, where A (B) corresponds to the vertex with beam (target)-like particles and α to the exchanged object, and is compared with the experimental weighted cross sections δ_w in different LPS sectors. The high confidence level of the fit over sixteen independent LPS sectors is surprising. (auth)

25884 PARTIAL WAVE CROSSING RELATIONS FOR MESON–BARYON SCATTERING. Steiner, F. (Univ., Karlsruhe, Ger.). Fortschr. Phys.; 19: No. 3, 115-158(1971).

Three different types of relations for meson–baryon partial wave amplitudes following from the s ↔ u crossing symmetry of the invariant amplitudes are investigated: i) the partial wave crossing relations directly derived from the s ↔ u crossing symmetry and the partial wave projection, ii) the partial wave crossing relations following from a combined use of s ↔ u crossing symmetry and analyticity, and iii) the crossing sum rules, which are a direct consequence of the s ↔ u crossing symmetry. The kernels entering the crossing relations i) and ii) are given in an analytic form, valid for arbitrary angular momentum. Their properties are studied in detail. By means of the partial wave crossing relations ii) it is demonstrated that u-channel exchange of a resonance leads to a resonance-like behavior of the partial wave amplitudes on the crossed physical cut. This phenomenon is described in terms of "pseudoresonances." Finally the crossing sum rules iii) and their practical use are thoroughly discussed, and they are compared with the partial wave crossing relations i) and ii). Special attention is paid to the crossing symmetry constraints on the S-wave amplitudes. As a result of these investigations a crossing symmetric ansatz is presented for these amplitudes which gives a more reliable parametrization than the usual effective range approximation. (auth)

25885 PARTON DISTRIBUTION AND LEVEL STRUCTURE OF DUAL HADRONS. Matsuda, S. (CERN, Geneva). Nuovo Cim.; 13A: No. 4, 983-1012(21 Feb 1973).

A model of hadrons is studied where a dual parton dynamics for the parton interaction is explicitly assumed. A parton distribution function and other interesting physical quantities based on the model are calculated. The study is strongly motivated by an interest in investigating a possible connection between the parton model and the dual-resonance model of hadrons. The main emphasis will be put on the transverse-momentum cut-off and scaling properties of particle distributions which are achieved as a consequence of the assumed level structure and its dual coupling scheme of hadrons. From the study of the model it is concluded that a particle distribution in an n-point Veneziano amplitude necessarily obeys the transverse-momentum cut-off of $\exp[-\gamma k_\perp^2]$, where γ must satisfy the condition $\gamma \geq 2 \ln 2$. (auth)

25886 QUARK MODEL FOR BARYON RESIDUES. Aye, T. M. (Imperial Coll. of Science and Tech., London). Nuovo Cim.; 13A: No. 4, 1013-1024(21 Feb 1973).

A model with a $\tilde{U}_{12}$-symmetric baryon Regge propagator is used to generate polynomial residues for πN backward scattering. Detailed calculations are made for the π^-p backward differential cross section and polarization, and reasonably good fits are obtained. The Δ_δ residue is found to extrapolate very well from the $\Delta(1236)$ pole to the scattering region, where it also exhibits its built-in peripheral character, giving Im $\Delta^{+-} \sim \tilde{J}_0$ and Im $\Delta^{++} \sim \tilde{J}_1$. However, the extrapolation of the N_α residue is rather uncertain due to a large symmetry-breaking effect. Detailed fits to the data suggest the need for a secondary effect like a Δ_β contribution and/or an absorptive cut for the less peripheral $\Delta^{+-}(\Delta\lambda = 0)$ amplitude. (auth)

25887 DYNAMICAL MECHANISM FOR THE DIFFRACTIVE DISSOCIATION REACTION $\pi \to 5\pi$. Celik, T. (Univ. of Rochester, NY); Meggs, W. J. Nuovo Cim.; 13A: No. 4, 1054-1064(21 Feb 1973).

A dynamical mechanism based on the multi-Regge model is used to investigate the diffractive dissociation reaction $\pi \to 5\pi$. The requirement that the peak in the five-pion mass distribution be independent of energy leads to a determination of the multi-Regge parameters as well as the mass and width of the enhancement. (auth)

25888 DOUBLE RESONANCE PRODUCTION AND THE EQUAL-PHASE HYPOTHESIS. Donohue, J. T.; Plaut, G. (Univ., Nice). Nucl. Phys.; B53: No. 3, 484-508(12 Mar 1973).

If all the helicity amplitudes for the reaction $0^- + \frac{1}{2}^+ \to J_1 + J_2$, $J_2 \geq \frac{3}{2}$, have the same phase, it follows that certain bilinear forms in the statistical tensors $t^{M_1 M_2}_{L_1 L_2}$, with L_1 and L_2 even, vanish. An intuitive discussion is given of how these tests of the equal-phase hypothesis arise, their relation to positivity constraints on the joint-density-matrix is studied, and their behavior in the limit of forward production is examined. In order to illustrate the sensitivity of these tests, calculations of helicity amplitudes and the corresponding bilinear forms were made, using reggeized absorption-model calculations for $\pi p \to \rho\Delta$. Some of the available data on $\pi p \to \rho\Delta$, $\pi p \to \omega\Delta$ and $K^+ p \to K^*\Delta$ are studied using our tests. Some recent high statistics data on $\rho\Delta$ indicate that the equal-phase hypothesis is incorrect for this reaction. A by-product of the investigation is the interesting result that if all the helicity amplitudes are in phase, and in the absence of a polarized target, one arbitrarily chosen helicity amplitude can be taken to be zero at an arbitrary value of the kinematic variables, without affecting any observable results. (auth)

25889 SPIN PREDICTIONS OF THE RELATIVISTIC QUARK MODEL FOR BARYON DECUPLET PRODUCTION. Montvay, I. (CERN, Geneva). Nuovo Cim.; 14A: No. 1, 207-214(1 Mar 1973).

Single-quark scattering contributions are considered in the case of ground-state decuplet baryon production. It is shown within the framework of an explicitly covariant approach that the spin consequences of the quark additivity assumption hold in the t-channel helicity frame independently of much of the details of the model. (auth)

25890 ANGULAR DISTRIBUTION OF SECONDARY PARTICLES IN π^-–p INTERACTIONS AT 60 GeV. Furmanska, B.; Gierula, J.; Holynski, R.; Krzywdzinski, S. (Inst. of Nuclear Physics, Krakow). Acta Phys. Pol.; B4: No. 1, 81-94(1973).

The asymmetry of the angular distribution of secondary particles in 60 GeV π^-–p interactions is investigated. In particular, the influence of the use of the ultrarelativistic transformation on the obtained values of the asymmetry parameters of angular distribution is estimated. The angular distributions of secondary particles in π^-–p interactions with primary energies 16 GeV and 60 GeV are compared. A simple approximate method of transformation of the angular distribution from the lab-system to the CM-system in the case of unknown masses and energies of produced particles is presented. The method is tested on 16 GeV π^-–p and 67 GeV p–p data. (auth)

25891 UNITARIZED MODEL OF QUASI-TWO-BODY CONTRIBUTIONS TO SINGLE PION PRODUCTION BY MESONS. Baracca, A. (Univ., Florence); Bergia, S. Fortschr. Phys.; 19: No. 4, 159-199(1971).

A general formulation is presented of resonant final state interactions (isobars) in single pion production by mesons with particular reference to the N* case. An essential use is made of the separation of the process into the quasi-two-body production and the decay steps. This allows the insertion of the isobar hypothesis into a scheme capable of dealing correctly with the spin-angular momentum aspects. A general scheme is developed for the exploitment of the two-channel unitarity conditions in a partial wave analysis of the isobar production amplitudes. The method for computing normalized distributions is finally outlined. (auth)

25892 INDEPENDENCE OF THE QUARK MODEL CLASS (A) RELATIONS FOR THE REACTIONS $0^- \frac{1}{2}^+ \to 1^- \frac{3}{2}^+$. Jaroszewicz, T. (Jagellonian Univ., Krakow). Acta Phys. Pol.; B4: No. 1, 21-25(1973).

It is shown that class (a) relations following from the additive quark model for the reaction $0^- \frac{1}{2}^+ \to 1^- \frac{3}{2}^+$ are not independent because some of the joint statistical tensors satisfy bilinear kinematical relations. (auth)

25893 EXPERIMENTAL KNOWLEDGE OF THE REAL PARTS OF THE $K^\pm p$ FORWARD SCATTERING AMPLITUDES. Dumbrais, O. V.; Dumbrais, T. Yu.; Queen, N. M. (Joint Inst. for Nuclear Research, Dubna, USSR). Fortschr. Phys.; 19: No. 8, 491-507 (1971).

A compilation of experimentally determined values of the real parts of the $K^\pm p$ forward scattering amplitudes is given in a form in which these data may be used directly in analyses of forward dispersion relations. The methods of determining these real parts from experimental data are briefly reviewed and a survey of $K^\pm p$ low-energy parametrizations and phase shift analyses is given. A summary is given of the theoretical determinations of the real parts. (auth)

25894 DOUBLE STATISTICAL TENSORS FOR RESONANCES PRODUCED BY POLARIZED PHOTONS. Gorczyca, B. (Jagellonian Univ., Krakow). Acta Phys. Pol.; B4: No. 1, 35-42(1973).

Double statistical tensors for resonances produced by polarized photons are presented. The joint decay distribution in double resonance production is expressed in terms of four double statistical tensors ${}^{(\alpha)}T$, $\alpha = 0, 1, 2, 3$. The tensor ${}^{(0)}T$ describes the process induced by unpolarized photons, while the tensors ${}^{(i)}T$, $i = 1, 2, 3$ correspond to the processes induced by linearly or circularly polarized photons. The quark model predictions for the decay distributions of resonances photoproduced in the reaction $\gamma B \to VB^*$ are rewritten in terms of four statistical tensors ${}^{(\alpha)}T$, $\alpha = 0, 1, 2, 3$. (auth)

25895 TEST OF THE ASSUMPTION OF EQUAL PHASES FOR ALL THE HELICITY AMPLITUDES IN THE PROCESS $0^- \frac{1}{2}^+ \to 1^- \frac{3}{2}^+$. Karczmarczuk, J. (Jagellonian Univ., Krakow); Zalewski, K. Acta Phys. Pol.; B4: No. 1, 27-33(1973).

The assumption of equal phases for all the helicity amplitudes is implicit in many models. Supplementing it by the class (a) relations predicted by the quark model it is found that the 19 parameters necessary to describe the decay distribution in the process $0^- \frac{1}{2}^+ \to 1^- \frac{3}{2}^+$ depend on four independent parameters only. Since the quark model predictions are well supported by experiment, the result is interpreted as a test for the assumption of equal phases for the helicity amplitudes. The test is used to analyze the available experimental data. (auth)

25896 SPIN AND PARITY ANALYSIS OF A MULTI-PRODUCTION AMPLITUDE IN THE Q REGION. Ranft, G. (Karl Marx Univ., Leipzig). Acta Phys. Pol.; B4: No. 1, 3-9(1973).

The spin and parity content of the double Regge amplitude for the reaction $K^+p \to K^{*0}\pi^+p$ at 7.3 GeV/c of Chien et al. is determined in the Q region. Only at the lower end of the Q band does the S wave dominate, so giving $J^P = 1^+$; at the upper end of the Q band many partial waves contribute with comparable strength. In the region where the S wave dominates the amplitude is predominantly real. Therefore, no resonance interpretation via duality is possible. (auth)

25897 LOW-ENERGY KAON–NUCLEON SCATTERING AND THE MAGNITUDE OF THE SIGMA COMMUTATOR. Reya, E. (Florida State Univ., Tallahassee). Phys. Lett.; 43B: No. 3, 213-216(5 Feb 1973).

A direct expression between low energy parameters and scattering lengths is presented for kaon nucleon scattering. As an application, the σ-term is calculated and agreement with various dispersive approaches is obtained. (auth)

25898 THEORY OF INTERACTING FERMI SYSTEMS. Bishop, R. F. Stanford, CA; Stanford Univ. (1972). 223p. University Microfilms Order No. 73-4469.

Thesis (Ph. D.).

The subject is an investigation of some model problems in the theory of interacting fermion systems. Different techniques for calculating such properties of both pure and impure systems as the ground-state energy and the excitation spectrum are discussed and compared. By way of introduction, the particular impure system of a lambda particle in nuclear matter is considered first, since this system provides one of the simplest nontrivial many-body problems we have. Two distinct approaches to calculating the lambda binding energy are discussed. The first is via the Bethe-Goldstone equation in the independent-pair approximation; while the second is a Green function formulation which sums the ladder diagrams, reckoned as Feynman diagrams, for the lambda self-energy. Exact solutions are given in both cases for an idealized separable interaction. The two solutions, with a simple form of this potential chosen to fit the available low-energy lambda-nucleon scattering data, are compared quantitatively with each other and with other more conventional calculations in the literature, and their relation is considered in detail. It is also shown that both of these methods can be regarded as the lowest-order limits of two distinct theories, employing Goldstone (G) and Feynman (F) diagrams respectively. Both methods involve a regrouping of the original perturbation series (in powers of the interaction potential), whereby the potential is eliminated in favor of the relevant scattering-matrix (different for each method) that sums the multiple scattering series for an interacting pair of particles. It is shown that when either theory is used beyond first order (in powers of the scattering-matrix), one needs to know the scattering-matrix for fully off-shell values of its arguments. Consequently, the two-body free scattering formalism is developed, paying particular attention to make it clear where the assumption of a "smooth" potential enters, since the results are applied to the hard-core many-fermion problem. As examples, the fully off-shell free scattering-matrices are found explicitly for both the pure hard-core interaction and its generalization, the boundary-condition model, without treating them as the limits of finite potential models, as previous calculations have done. Finally, the F and G methods are each applied to both the pure and impure many-fermion systems, interacting via a general repulsive two-body potential; and a series expansion is developed for the ground-state energy of each system. (JFP)

25899 INVESTIGATIONS INTO THE NATURE OF ρ TRAJECTORY. Bari, M. B. (Univ. of Tabriz, Iran); Nami, F.; Alam, M. A. J. Natur. Sci. Math.; 12: No. 1, 35-38(Apr 1972).

We show that in high energy reactions dominated by δ-exchange in t-channel there is a significant failure of factorization. Also there is significant indication that a mixture of parities is exchanged. This implies that δ-particle exists as a parity doublet. It is conjectured that similar behavior should occur for other low lying meson trajectories. (auth)

25900 FINITE ENERGY SUM RULES FOR PIN → PIN*. Alam, M. A. (Univ. of the Punjab, Lahore); Bari, M. B. J. Natur. Sci. Math.; 12: No. 1, 31-33(Apr 1972).

The finite energy sum rule for one of the invariant amplitudes of the process $\pi + N \to \pi + \Delta(1236)$ is discussed. A value of 1.95 is found for the ratio of the coupling strengths at the NN and N*N* vertices. (JFP)

25901 ESTIMATE OF THE σ-TERM IN KN SCATTERING. Banerjee, S. N. (Univ. of California, San Diego, La Jolla). Lett. Nuovo Cim.; 6: No. 11, 412-414(17 Mar 1973).

The off-mass-shell Veneziano amplitude for KN scattering is constructed, which is consistent with the Adler–Weisberger sum rule. A satisfactory estimate of the σ term is obtained. (LBS)

25902 DUAL-PARTON MODEL AND THE HIGH ENERGY PION–NUCLEON SCATTERING IN THE FORWARD AND BACKWARD REGIONS. Bandyopadhyay, P. (Indian Statistical Inst., Calcutta); De, S. S. Nuovo Cim. 14A: No. 2, 285-298(21 Mar 1973).

On the basis of the dynamical dual-parton model of strong interactions as discussed in an earlier paper, the high-energy processes $\pi^\pm p \to \pi^\pm p$, $\pi^+ p \to n\pi^0$ in the forward and backward regions are studied. To incorporate the concept of duality, it is assumed that any two spin-$\frac{1}{2}$ pointlike constituents (partons) can form a π-meson cluster in the structure of a nucleon and the basic interaction involved in MB scattering is the interaction of the incident meson with the π-meson in the structure of the nucleon. To calculate the amplitudes for the relevant processes, a factor corresponding to the structural re-arrangement of partons involved in duality diagrams is also taken into account. The differential cross sections as well as the energy dependence are found to be in excellent agreement with the experimental data. Also, this model can nicely explain the fact that all these processes in the forward regions are characterized by dips in differential cross sections, but in the backward region, though the processes $\pi^+p \to p\pi^+$, $\pi^-p \to n\pi^0$ are characterized by dips, no such dip occurs in the process $\pi^-p \to p\pi^-$. (auth)

25903 DOES ASYMPTOPIA BEGIN AT 5 GeV/c IN πN SCATTERING. Hoehler, G.; Jakob, H. P. (Institut fuer Theoretische Kernphysik, Karlsruhe, Ger.). Lett. Nuovo Cim.; 6: No. 11, 389-396(17 Mar 1973).

It is shown that the formula $\sigma^+ \equiv \frac{1}{2}(\sigma_- + \sigma_+) = (s/4q^2)\hat{\sigma}$ gives a good fit to the total cross-section data for πN interactions in the range 4 to 60 GeV/c, although it has only one adjustable parameter. In addition to a comparison with the data an evaluation of the forward dispersion relation based on the high-energy behavior is presented in order to check whether the formula gives real parts of the amplitude in agreement with those derived from Coulomb interference measurements. (LBS)

25904 TOLLER POLE ANALYSIS OF DIP STRUCTURE IN $0^- + \frac{1}{2}^+ \to 1^+ + \frac{1}{2}^+$ PROCESSES. Mir, K. L. Punjab Univ. J. Math.; 5: 23-31(Nov 1972).

It is shown that according to 0(3,1) symmetry model, the differential cross sections for near-forward scattering in $0^- + \frac{1}{2}^+ \to 1^+ + \frac{1}{2}^+$ reactions should exhibit dip at $\alpha = 0$ and $\alpha = -1$. These predictions are not inconsistent with the recent experimental data available for $\pi^+p \to B^+p$. (auth)

25905 $\pi N \to Ne^+e^-$ PROCESSES AT HIGH ENERGIES. Kulish, Yu. V. (Physical-Technical Inst., Kharkov). Ukr. Fiz. Zh. (Russ. Ed.); 17: No. 12, 2057-2060(Dec 1972). (In Russian).

The processes of the lepton pair production during the interaction of the high energy π-mesons with nucleons, $\pi + N \to N + ll$ are considered in the region of small |t| values (t is a square of the four-momentum transfer between the initial and final nucleons). A one-pion gauge invariant model is applied for calculating the process $\pi N \to Ne^+e^-$ cross section. It takes into account the interaction of the photon only with the electric charge of particles, by analogy with photo- and electroproduction of charge π-mesons on nucleons in the corresponding kinematical region. (auth)

25906 STABLE EXTRAPOLATION OF SCATTERING AMPLITUDES USING UNITARITY. Yndurain, F. J. (CERN, Geneva). Ann. Phys. (N. Y.); 75: No. 1, 171-218(Jan 1973).

Unitarity in all three channels for the πN system is used to show that one can, given the first LπN partial waves and the πN total cross sections, extrapolate to find the NN → $\pi\pi$ waves, the whole amplitude, and the πN waves, in the unphysical regions and this within absolute error bands, and from either of those quantities, we construct Padé approximants which are then shown to converge to the cuts ($4\mu^2 \leq t \lesssim 2M^2$) again here within an explicit

error band. It is shown that the method is stable under perturbations, giving also the explicit form in which such perturbations propagate. The analysis is carried first for amplitudes with positivity, and then extended to any amplitude. Only a general outline is presented. (auth)

Strong (Baryon No. ≥ 2)

Refer also to abstracts 25752, 25757, and 26399.

25907 (IFVE-SEF-71-22) EMPIRICAL FORMULA FOR PION AND KAON SPECTRA IN pp–INTERACTION. Folomeshkin, V. N. (Gosudarstvennyi Komitet Po Ispol'Zovaniyu Atomnoi Energii SSSR, Serpukhov. Institut Fiziki Vysokikh Energii). 1971. 18p. (In Russian). INIS.

An empirical formula was proposed for the description of the spectra of pions and kaons generated in pp interactions in a wide range of angles and secondary particle energy. (tr-auth)

25908 (JINR-P4-6913) QUARTET S-PHASE OF ND SCATTERING BELOW THE THRESHOLD IN LINEAR APPROXIMATION ON INTERACTION RADIUS. Efimov, V. N.; Tkachenko, E. G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1973. 15p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

Linear approximation on the interaction radius, independent of the potential form, is used in calculating the quartet s-phase of nd scattering below the deuteron disintegration threshold. Calculation results agree well with experimental data. A value of 6.06 fm, close to experimental 6.35 fm, is obtained for the quartet length of nd scattering. (auth)

25909 (NP-19690) THREE-BODY CALCULATION FOR POLARIZATION EFFECTS IN THE NEUTRON–DEUTERON SCATTERING. Doleschall, P. (Helsinki Univ. (Finland). Research Inst. for Theoretical Physics). Sep 1972. 57p. Dep. NTIS (U. S. Sales Only) $5.00.

The Faddeev equations with separable two-particle interactions have been solved for the 2n + p system at energies 14.1 MeV and 22.7 MeV respectively. The simultaneous and single effect of the S-, P-wave interactions and tensor force on the differential cross section and polarizations has been studied. The experimental data have not been reproduced satisfactorily. A method different from the contour deformation method has been suggested to treat the singularities of the kernels of the Faddeev integral equations. (auth)

25910 (RLO-2041-79) MODELS FOR POLARIZATION STRUCTURE AT HIGH ENERGIES. Miyamura, O.; Kawaguchi, M.; Moravcsik, M. J. (Osaka Univ. (Japan). Dept. of Applied Mathematics; Oregon Univ., Eugene. Dept. of Physics). 1972. 13p. Dep. NTIS $3.00.

A number of simple intuitive models are considered for high energy amplitudes of particle reactions, and their consequences are calculated for high energy nucleon–nucleon interaction in terms of predictions for the various experimental observables involving polarized particles. A prescription is given for the set of experiments which can test the models. (auth)

25911 DEUTERON TENSOR MOMENTS FOR INTERMEDIATE ENERGY NEUTRON–DEUTERON SCATTERING. Miller, R. A. (Coll. of William and Mary, Williamsburg, VA); Remler, E. A.; Wilson, J. W. Nucl. Phys., B; B53: No. R366-394, 395-409(26 Feb 1973).

Calculations of the tensor moments of deuteron polarization in neutron–deuteron scattering between 77 and 300 MeV lab kinetic energy are presented in the hope that they will motivate measurements in this currently neglected area. The moments are found to be large compared with their maximum possible values, in contrast with the experience at lower energies. The reaction model on which the calculations are based is a form of single scattering. The single scattering integral is evaluated numerically and a novel method is made for obtaining the necessary off-shell two-nucleon amplitudes based on relativistic considerations. The results are compared with the results obtained using a more complete model employing nucleon exchange and a phenomenological s-wave representing higher-order multiple scattering. In this way it is demonstrated that the results are relatively independent of the less known contributions to the scattering amplitude, if attention is restricted to the forward hemisphere. The sensitivity of these results to the D-state percentage of the deuteron is also discussed. (auth)

25912 $\Lambda n/\Lambda p$ STIMULATION RATIO IN THE NONMESONIC DECAYS OF HEAVY HYPERFRAGMENTS. Mangotra, L. K. (Univ. of Jammu, India); Sangal, B. R.; Sharma, M. L.; Gupta, S. C.; Singh, T.; Prakash, Y.; Goel, S. P. Nuovo Cim.; 13A: No. 3, 826–836(1 Feb 1973).

The neutron to proton stimulation ratio of the Λ-hyperon ($\Lambda n/\Lambda p$) in the nonmesonic decays of heavy hyperfragments of mass $A \gtrsim 10$ produced from the K^- captures in nuclear emulsion is studied. The procedure is based on the comparison of the experimental proton and total visible energy spectra at the decay centers of hyperfragments with the corresponding results obtained from the Monte Carlo calculations. The value of the ratio is estimated to be ≈2. (auth)

25913 MULTIPION PRODUCTION IN THE ISOSPIN CONSERVATION MODEL. Dadic, I.; Martinis, M.; Pisk, K. (Inst. Rudjer Boskovic, Zagreb). Nuovo Cim.; 13A: No. 3, 777-786 (1 Feb 1973).

The isospin conservation model for pion production is discussed. Within the expected limitations of applicability the model gives the following results: (a) $\sigma_t(pp) = \sigma_t(pn)$; (b) $\langle n_0 \rangle = \frac{1}{3}\langle n \rangle$; the isospin of the pion cloud is (c) I(pion cloud) = 0 or 1; (d) for the charge multiplicity $\langle n_c \rangle$ the functional dependence of $\langle n_c \rangle / D_c$ on $\langle n_c \rangle$ is obtained, which is in good agreement with the existing data; (e) $\sigma(pp \to pn\pi^+)/\sigma(pp \to pp\pi^0) = 2$, $\sigma(pp \to pn\pi^+)/\sigma(pn \to pp\pi^-) = 2$; (f) the average number of protons $\langle n_p \rangle$ is $\langle n_p \rangle \to \frac{5}{3}$ as $\langle n \rangle \to \infty$. (auth)

25914 INCLUSIVE THERMODYNAMICAL SPECTRA IN THE RANGE 19 TO 1500 GeV/c. Letessier, J.; Tounsi, A. (Institut de Physique Nucleaire, Paris). Nuovo Cim.; 13A: No. 3, 557-582(1 Feb 1973).

Inclusive spectra in p-p collisions are computed in the framework of the thermodynamical model. Improvements of previous fits are explained by the use of Frautschi's hadronic mass spectrum with the assumptions of "strict locality" in quantum number conservation laws and of a single fireball velocity function for all processes. Predictions at CERN ISR energies are in very good agreement with the present data. Scaling properties are discussed and some indications on the domain of their validity are given. (auth)

25915 PHENOMENOLOGICAL ANALYSIS OF PROTON–PROTON SCATTERING FROM 50 TO 1000 MeV. Chastel, A. (Ecole Polytechnique, Paris). J. Phys. (Paris), Colloq.; No. 5, 162(1972).

A relativistic theory of p–p scattering is presented. (FR)

25916 HADRONIC ATOMS. Scheck, F. (Eidgenoessische Technische Hochschule, Zurich). J. Phys. (Paris), Colloq.; No. 5, C5.183–C5.193(1972).

Two new results concerning the measurement of spectroscopic quadrupole moments and radiative corrections for muonic atoms are presented. Some of the basic properties of hadronic atoms and the corresponding theoretical analysis are reviewed. Applications to the study of nuclei (neutron distributions, quadrupole mass densities) as well as original applications to the investigation of the properties of the captured particle (polarizability) and the particle–nucleon scattering amplitude in the nucleus (off-shell extrapolation and correlation effects) are presented. (FR)

25917 S-CHANNEL VIEW OF THE ISR CENTRAL-REGION DATA. Dias de Deus, J. (Univ. of Copenhagen). Lett. Nuovo Cim.; 6: No. 9, 341-345(3 Mar 1973).

Some problems in connection with the questions of asymptotic limits and quark-duality structure for s-channel formation mechanisms and the process $(ab)\bar{c} \to (ab)\bar{c}$ are discussed. Data on $pp \to \pi X$, $p + p \to pX$ and $p + p \to KX$ at ISR energies are examined. (LBS)

25918 INCLUSIVE SPECTRA IN SINGLE- AND DOUBLE-EXCITATION MODELS. Le Bellac, M.; Donohue, J. T.; Meunier, J. L. (Univ., Nice). Nuovo Cim. 14A: No. 2, 225-244(21 Mar 1973).

The inclusive pion spectra in p-p collisions predicted by the single-excitation (or Nova) model and the double-excitation model are discussed. The description is given in terms of the rapidity y, which facilitates the comparison of the two models. Whereas in the limit of infinite energies the two models may be shown to have the same form, their predictions at accelerator and even at ISR energies differ appreciably. In particular the question of how the scaling limit in the central region is reached, and which factors in the model govern the approach is discussed. The problem of enforcing a cut-off in momentum transfer is examined, and it is found that the effect of such a cut-off is to cause a dip in the central plateau. However the effect is much more severe for the double-excitation model than for the single-excitation one. Furthermore the contribution of the two-fireball model to the inelastic cross section is found to increase considerably between accelerator and ISR energies, to such an extent that it should be the dominant process at very high energies. (auth)

25919 COMMENTS ON LIGHT-CONE PRESENCE AND USE OF SPECTRAL REPRESENTATIONS FOR MASSIVE MUON-PAIR

PRODUCTION. Konetschny, W.; Schweda, M. (Technische Hochschule, Vienna). Lett. Nuovo Cim.; 6: No. 10, 367-373(10 Mar 1973).

Comments are made on the kinematic presence of the light cone and the use of spectral representations for massive muon-pair production in the interaction $p + p \rightarrow \mu^+\mu^- + X$. (auth)

Particle Invariance Principles and Symmetries

General

Refer also to abstracts 25849, 25956, 25993, and 26700.

25920 (IFVE-STF-71-42) PLANCHEREL MEASURE FOR THE BASIC CONTINUOUS SERIES OF UNITARITY REPRESENTATIONS OF SEMISIMPLE LIE GROUPS. Leznov, A. N. (Gosudarstvennyi Komitet Po Ispol'zovaniyu Atomnoi Energii SSSR, Serpukhov. Institut Fiziki Vysokikh Energii). 1971. 27p. (In Russian). INIS.

The explicit form was obtained for the Plancherel measure of the basic continuous series for the unitarity representation of the classical Lie group and its virtual form. (tr-auth)

25921 PROPER POINCARE INVARIANCE IN THE DETERMINATION OF ARBITRARY-SPIN WAVE EQUATIONS: CONSTRAINTS FROM DISCRETE SYMMETRIES. Jayaraman, J. (Univ. of Madras). Nuovo Cim.; 13A: No. 4, 877-896(21 Feb 1973).

An explicit determination is made of the most general forms possible for the Hamiltonian H in the standard Schroedinger form $i(\partial\psi/\partial t) = H\psi$ (with ψ transforming according to $D(0,s) \oplus D(s,0)$) of wave equations for free particles of arbitrary spin s and nonzero mass, when the wave equation is required to be invariant under the continuous transformations of the Poincaré group only. The further constraints on H which arise from invariance under each of the discrete operations T, C and P individually and under the combined operation $\Theta = TCP$ are systematically explored. The analysis shows that, when taken in conjunction with proper Poincaré invariance, the symmetry of a free-particle wave equation under any of the operations Θ, P, C, T implies (with one trivial exception) the symmetry under each of the succeeding ones in the above ordering. (auth)

25922 TRANSFORMATION FUNCTIONS FROM THE JM-BASIS TO THE Z BASIS FOR THE UNITARY REPRESENTATIONS OF $SL_{2,C}$. Paciello, M. L. (Univ., Naples); Sciarrino, A.; Taglienti, B. Nuovo Cim.; 13A: No. 4, 1078-1088(21 Feb 1973).

The covariance properties of the transformation functions from the jm-basis to the z-basis are written down and solved explicitly for irreducible unitary representations of $SL_{2,C}$ belonging to the principal series. The explicit expression of these functions in terms of elementary functions is given. Some interesting completeness and orthogonality properties for the expansion of one- and two-variable complex functions are pointed out. (auth)

25923 GROUP RING OF A DYNAMICAL INVARIANCE GROUP. Dirl, R.; Angerer, G. (Technische Hochschule, Vienna). Nuovo Cim.; 13A: No. 4, 1065-1077(21 Feb 1973).

SU_2, a group of unitary operators isomorphic to the 2-dimensional unimodular unitary group, is the dynamical invariance group of the 2-dimensional harmonic oscillator. The corresponding group ring $L[SU_2]$ is used to classify completely the eigenfunctions, to represent arbitrary operators having nonvanishing matrix elements only within irreducible representations as unique functions of some special ring elements, and to construct general irreducible tensor operators whose matrix elements obey the known selection rules (Wigner–Eckhart theorem). (auth)

25924 INVARIANTS OF THE ROTATION GROUP. Marinov, M. S.; Roginsky, V. I. Fortschr. Phys.; 19: No. 8, 509-527(1971).

Any quantity transforming according to an irreducible representation of the space rotation group may be realized in three forms: i) as a multispinor $\chi_{\alpha_1\ldots\alpha_{2l}}$; ii) as a 3-tensor $t_{i_1\ldots i_l}$ (for 2l even) or, tensor-spinor $t_{\alpha i_1\ldots i_{l-\frac{1}{2}}}$ (for 2l odd); iii) as an l-spinor ψ^l_λ ($\lambda = -l,\ldots,l$). Only one invariant may be constructed of three quantities of a given kind; so the three invariants are equal up to a numerical factor that is found in the work. A number of invariants may be constructed of four quantities, not all of them independent. For applications it is of importance to be able to construct an independent set of invariants of every kind, as well as to relate the invariants of different kinds. This problem is solved in the present work for arbitrary angular momenta l_1, l_2, l_3, l_4. (auth)

25925 EXPLICIT TIME-REVERSAL VIOLATING INTERACTIONS FOR NUCLEAR PHYSICS. Clement, C. F. (Atomic Energy Research Establishment, Harwell, Eng.). Ann. Phys. (N. Y.); 75: No. 1, 219-248(Jan 1973).

By starting from a T-violating Lagrangian involving the nucleon, meson, and electromagnetic fields interacting at a point, the one-meson-exchange diagram is calculated and the longest-range part of a two-nucleon electromagnetic operator is obtained. The cases when the meson is scalar, pseudoscalar, and vector are considered. For the radiation of a real photon the multipole expansions of the transition operators are obtained. The properties and expected magnitudes of the resulting explicit two-nucleon transition operators are examined and compared with the normal operators. With the interactions at maximal strength any contributions from the vector operators are negligible, and violations from the other operators are likely to reach the order of 10^{-3} only where the normal transitions are strongly inhibited. When the photon is virtual, the interactions lead to explicit T-violating three-nucleon potentials. These potentials give practically no contributions to optical model potentials. The best reciprocity experiments appear to be nucleon-transfer reactions, and there could be violations of the order of 10^{-3} in (d,p) reactions from the pseudoscalar potential. This potential is shown to give a stripping amplitude with angular properties very different from the normal one. (3 tables) (auth)

25926 PROPERTIES OF NON-UNITARY ZERO MASS INDUCED REPRESENTATIONS OF THE POINCARE GROUP ON THE SPACE OF TENSOR-VALUED FUNCTIONS. Barut, A. O.; Raczka, R. (Univ. of Colorado, Boulder). Ann. Inst. Henri Poincare, Sect. A; 17: No. 2, 111-118(1972).

The theory of induced representations is used to discuss a class of indecomposable representations of the Poincare group in Hilbert space with an indefinite metric which occur in theories with zero-mass particles. The formalism provides a number of further generalizations to representations with $m^2 < 0$, and to infinite-component tensor fields. (France)

25927 DIFFERENTIAL GEOMETRY AND LIE SYMMETRY GROUPS. Oliveira, C. G. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). Notas Fis., Cent. Brasil. Pesqui. Fis.; 19: No. 1, 3-80(1972).

The theory of Lie groups was previously applied to physical motions represented by ordinary differential equations. This work is extended to partial differential equations. (JFP)

25928 OCTONIONIC REPRESENTATION OF THE POINCARE GROUP. Guenaydin, M. (Yale Univ., New Haven); Guersey, F. Contract AT(11-1)-3075. Lett. Nuovo Cim.; 6: No. 11, 401-406 (17 Mar 1973).

A Hilbert space with state vectors with real octonion components is considered and an attempt is made to find unitary representations of the Poincare group in this space. The approach is based on the interpretation of the gauge group of the new representation of the Poincare group as an internal symmetry group. (LBS)

25929 SHIROKOV'S METHOD AND SKIN ALGEBRAS OF THE POINCARE GROUP. Pirotte, C. (Univ., Liege). Physica; 63: No. 2, 373-383(15 Jan 1973). (In French).

In this study of the irreducible unitary representations [m,s] of the Poincaré group, the method of Shirokov is applied to equivalent spin algebras containing the helicity operator as an element. Recent explicit forms of generators of the Poincaré group are obtained directly. (auth)

Applications (Electromagnetic and Weak)

25930 (DESY-72/79) GENERAL CHIRAL SYMMETRY BREAKING IN K_{l3} DECAYS. Kazi, A. H. (Deutsches Elektronen Synchrotron, Hamburg (West Germany)). Dec 1972. 15p. Dep. NTIS (U. S. Sales Only) $3.00.

The K_{l3} vertex is considered in the technique of generalized Ward identities allowing arbitrary chiral symmetry breaking. The 1st Weinberg sum rule is derived, and constraints are found on the parameters of chiral symmetry breaking in a single particle approximation to 2-point spectral functions. In the limit $m_i^2 \rightarrow 0$ these constraints make all effects of general chiral symmetry breaking indistinguishable from those of a $(3,\bar{3}) + (\bar{3},3)$ scheme, if unmotivated divergences are to be avoided. We conclude that in the present framework the K_{l3} vertex does not allow us to distinguish between different models of chiral symmetry breaking, except for terms of order $0(m_i^2)$. (auth)

25931 (ITF-72-179-E) ANALYTIC REPRESENTATIONS OF THE CONFORMAL GROUP IN FOUR AND FIVE DIMENSIONS CONNECTED WITH DIFFERENTIAL EQUATIONS. Muggli, J. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1972. 38p. Dep. NTIS (U. S. Sales Only) $4.00.

The conformal group C_d is represented by analytic spinor representations in the complex symmetric domain corresponding to the group. In four dimensions for every spin there exists one irreducible representation solving invariantly a wave equation and thus describing a massless particle. For massive particles, nonlinear differential equations in five dimensions with the proper time as fifth coordinate are found, which are covariant under the conformal group O_5 and invariant under the invariance group for massive particles GCO_5 containing the Poincare group (P(4), dilatation, and proper time translation. The most simple system of equations is tentatively ascribed to the electron-positron system connected with electromagnetic and gravitational fields. The Lorentz group L(4) can be extended by adding Lie elements from O_5 to the direct product of L(4) and SO(2,1), probably connected with isospin. (auth)

25932 TRACKING THE CP BREAKDOWN. Marx, G. (Roland Eoetvoes Univ., Budapest). pp 29-60 of Symposium on Nucleons and Weak Interactions. Eman, B. (ed.). Zagreb; Institute Rudjer Boskovic (1971).

From Symposium on nucleons and weak interactions; Zagreb, Yugoslavia (Jul 1971). See CONF-710737-.

CP violation in neutral kaon decays is discussed. The neutral K meson system, symmetries and asymmetries, experimental data, unitarity, CP breakdown in $K \to 2\pi$ decays, and the minimum model are covered. (JFP)

Applications (Strong)

25933 PERMUTATION GROUPS AND STRONG INTERACTIONS. Allanche, J. D. (Univ. du Dahomey, Porto-Novo). Nuovo Cim.; 14A: No. 1, 71-84(1 Mar 1973). (In French).

A formulation is presented of the internal properties of symmetry for strong interactions on the basis of the permutational group of order 4, and this in view of finding the minimal group of invariance linked to the internal formalism. The phenomenological symmetry between the four leptons and four "basic" baryons suggests the existence of four fundamental baryonic fields. For these fields the four components of a quadri-field U constructed with three fields of Yang and Mills attached to the respective conservations of Y, I and B are taken. These fundamental fields admit a symmetry with respect to the self-representation of the group S_4 whose reduction allows us to isolate a time-type function among the introduced fields (called A, B, C, D). The mesons are considered as combinations antibaryon-baryon and they are obtained by reducing the product $\bar{S}' \times S'$, S' being the reduced self-representation of S_4. The formalism is general, the obtained Hamiltonian having a form independent of the identification of A, B, C, D by known baryonic fields. Moreover, that Hamiltonian depends on four coupling constants which correspond precisely to the supposed number of fundamental fields. (auth)

25934 PARITY VIOLATION IN NUCLEON–NUCLEON INTERACTIONS. Fischbach, E. (Purdue Univ., Lafayette, IN); Tadic, D. pp 61-98 of Symposium on Nucleons and Weak Interactions. Eman, B. (ed.). Zagreb; Institute Rudjer Boskovic (1971).

From Symposium on nucleons and weak interactions; Zagreb, Yugoslavia (Jul 1971). See CONF-710737-.

The discussion of parity violation in nucleon–nucleon interactions covers the parity-violating internucleon potential and models of the weak Hamiltonian, the parity violating internucleon potential in nuclear physics calculations and gauge invariance, and general features and open problems. (JFP)

Field Theories

General

25935 INVARIANT REGULARIZATION OF THE ONE-MESON LOOP IN CURVED SPACE–TIME. Geist, G.; Kuehnelt, H.; Lang, W. (Univ., Karlsruhe, Ger.). Nuovo Cim.; 14A: No. 1, 103-116 (1 Mar 1973).

The regularization of the one-meson loop in the presence of an external gravitational field by the 't Hooft–Veltman method is shown to be possible in an Einstein-invariant manner. (auth)

25936 NOTE ON PERNG'S UNIFIED FIELD THEORY. Chang, S. C.; Janis, A. I. (Univ. of Pittsburgh). Ann. Inst. Henri Poincare, Sect. A; 17: No. 3, 291-293(1972).

Based on Perng's assumptions and a fundamental property of a symmetric affine connection, a simple argument shows the inconsistency of Perng's theory. (France)

25937 ELECTROMAGNETISM AND GRAVITATION. Prasanna, A. R. (International Centre for Theoretical Physics, Trieste, Italy). Lett. Nuovo Cim.; 6: No. 11, 420-422(17 Mar 1973).

A new set of field equations for the combined electromagnetic and gravitational field is obtained by introducing an interaction term which makes use of the fundamental tensors of both these fields. With the new field equations it is found that in a space of constant curvature the electromagnetic field tensor satisfies the Maxwell equation for free space. (LBS)

25938 SPATIALLY FLAT SPACE–TIME IN EINSTEIN'S UNIFIED FIELD THEORY. Tiwari, R.; Kashyap, J. N. S. (Banaras Hindu Univ., India). Indian J. Pure Appl. Math.; 3: No. 3, 455-459(May 1972).

A solution of the field equations in Einstein's unified field theory has been obtained. The nonstatic field which describes a spatially flat space–time and is of electromagnetic origin turns out to be static. It is singular all along the z-axis. (auth)

Quantum Field Theory

Refer also to abstracts 25622, 25633, 25634, 25926, and 25984.

25939 (DESY-73/2) ON THE SHORT DISTANCE BEHAVIOUR OF THE AXIAL VECTOR CURRENT. Koeberle, R.; Nielsen, N. K. (Deutsches Elektronen-Synchrotron, Hamburg (West Germany)). Jan 1973. 17p. Dep. NTIS (U. S. Sales Only) $3.00.

Using the Callan–Symanzik equations as a tool to study the short distance behavior of the gauge invariant axial vector current in quantum electrodynamics, we conclude that as a consequence of Ward-identities the axial vector current is required to scale non-canonically. The Wilson–Crewther calculation of the anomaly can not be carried out, although its use is legitimate in phenomenological applications treating electromagnetism to lowest order. (auth)

25940 (ITF-72-163-E) GENERATING OPERATORS AND HAMILTONIAN IN THE MODEL $g(:\varphi^4:)_2$ AT INFINITE VOLUME. Petrina, D. Ya.; Ivanov, S. S.; Rebenko, A. L. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1972. 37p. Dep. NTIS (U. S. Sales Only) $4.00.

Using the model $g(:\varphi^4:)_2$, it is shown that it is possible to describe the systems of quantum field theory directly at infinite volume. The generating operator of the equations for the S-matrix coefficient functions in the Euclidean domain as well as the Hamiltonian of theory are proved to be well defined on a set everywhere dense in a Hilbert space of translationally invariant functions h^T. (auth)

25941 (ITF-73-7-P) PROOF OF THE FORMULA $R_\Gamma = \sum_{F_\Gamma \in \mathcal{F}_\Gamma} \prod_{\lambda \in F_\Gamma} (-t^\lambda)\, T_\Gamma$. Gorban, E. N. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1972. 17p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

A detailed treatment is given of the Zimmermann proof of the formula $R_\Gamma = \sum_{F_\Gamma \in \mathcal{F}_\Gamma} \prod_{\lambda \in F_\Gamma} (-t^\lambda)\, T_\Gamma$. (auth)

25942 (JINR-E2-6939) DYSON EQUATION FOR THE TWO PARTICLE GREEN FUNCTION AND THE BOUND STATE PROBLEM. Faustov, R. N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 15p. Dep. NTIS (U. S. Sales Only) $3.00.

A new Dyson-like equation for the kernel of the Bethe–Salpeter equation is deduced. Such a representation for the kernel permits partial summation of irreducible diagrams to be performed which is necessary in the presence of bound states in quantum electrodynamics. Thereby the calculation of the energy shifts in hydrogenic atoms is considerably simplified. (auth)

25943 (JINR-P2-6938) ULTRAVIOLET ASYMPTOTICS OF PROPAGATORS AND THE HIGHEST GREEN FUNCTIONS. Shirkov, D. V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973). 31p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.75.

We consider the problem of determination of ultraviolet asymptotics of Green functions in quantum field theory by the renormalization group method. Solution of functional equations for the highest Green functions is carried out by the Ovsyannikov method. It is shown that power asymptotics for propagators as well as automodel expressions for the highest Green functions can be obtained both at finite and infinite renormalizations of the coupling constants. (auth)

25944 LOCAL SOLUTIONS IN PREDICTABLE RELATIVISTIC DYNAMICS. Droz-Vincent, P. (College de France, Paris). Compt. Rend., Ser. A, B; 275: No. 23, 1263-1265(6 Dec 1972). (In French).

The Cauchy-Kowalewski theorem is used to establish local solu-

tions to the predictability conditions of relativistic two-body systems. (France)

25945 GEOMETRICAL SCHEME WITH AN ASYMMETRIC MOMENTUM ENERGY TENSOR. Application to Relativistic Studies of Matter with Spin. Clerc, R. L. (Univ., Toulouse). Ann. Inst. Henri Poincare, Sect. A; 17: No. 3, 259-290(1972). (In French).

It is possible to adapt the generalized theory of variational spaces of A. Lichnerowicz to the study of trajectories using a semi-symmetric connection of Schouten. The equations of motion are written in a form permitting the generalization of a classical theorem for matter with spin. It is demonstrated that Einstein's asymmetric equations can be established on V_4. The spin density is defined. When V_4 is provided with a decomposable connection, properties are obtained recalling certain results of the Dirac theory. (France)

25946 AFFINE PROPERTIES OF THE LIGHT CONE AND THEIR APPLICATION IN THE QUANTUM ELECTRODYNAMICS. Staruszkiewicz, A. (Jagellonian Univ., Krakow). Acta Phys. Pol.; B4: No. 1, 57-63(1973).

It is shown that there exists on the light cone an affine connection which is metric, semisymmetric and totally integrable. The connection is used to displace parallel polarization vectors of the photon; a new gauge for the electromagnetic field is thus introduced and the commutator of two potentials in the new gauge is calculated. The commutator is invariant with respect to the four-parameter group which leaves invariant a fixed null direction. (auth)

25947 GENERALIZED LORENTZ TRANSFORMATIONS IN FOUR DIMENSIONS AND SUPERLUMINAL OBJECTS. Mignani, R.; Recami, E. (Univ., Catania, Italy). Nuovo Cim.; 14A: No. 1, 169-189(1 Mar 1973).

A new group G of Lorentz transformations (LT) in four dimensions, generalized also for Superluminal frames, is introduced and particularly studied in its physical implications. With the help of a "principle of duality"—implied by G—between subluminal and Superluminal frames, the meanings of "inertial frame," "equivalence," "principle of relativity," "covariance" may be correspondingly extended. A biunivocal correspondence exists between bradyonic and tachyonic velocities, which is found to be a particular conformal mapping (inversion). Since the group G consists of generic rotations in space-time, it includes, e.g., also the total-inversion operation (PT). Moreover (for a non "charge"-free universe), it is shown that the generalized special relativity requires covariance under CPT. A "tachyonization principle" is formulated, on the basis of which relativistic physical laws (of mechanics and electrodynamics, at least) can be easily extended to tachyons. Many simple applications are performed of the generalized LT's (velocity composition law, comparison of the length and time units, Doppler effect, refraction index, ...), either useful to clarify the problem or interesting in astrophysics. (auth)

25948 INTERACTING BHABHA FIELD WITH ARBITRARY SPIN. Nagpal, A. K. (Univ. of Delhi). Nucl. Phys.; B53: No. 3, 634-642(12 Mar 1973).

The Bhabha equation which describes a particle having multi-mass and spin states with maximum spin S, integer or half an odd integer, is considered. In the presence of interactions e.g., the electromagnetic interaction introduced through minimal coupling, it is found to yield the same (anti-) commutators as in the case of a free field. Also the propagation of an interacting field is causal. This shows the absence of inconsistencies of the type pointed out by Johnson and Sudarshan. Finally the applicability of the methods of quantization is discussed. (auth)

25949 THEORY OF CANONICAL SCALING. Brandt, R. A.; Ng, W. C. (Max-Planck-Institut fuer Physik und Astrophysik, Munich). Nuovo Cim.; 13A: No. 4, 1025-1053(21 Feb 1973).

It is discussed how canonical Bjorken scaling can be realized in canonical field theories. It was previously shown that naive canonical manipulations lead to conflict with irreducible scale invariance, but it is shown here that no such inconsistencies arise provided one invokes only reducible scale invariance (RSI) and defines composite operators carefully from short-distance operator-product expansions (SDE). Noncanonical singularities can still arise in the current-current product under the above assumptions. Such noncanonical behavior is excluded, however, provided that the SDE are governed by the new symmetry of field-shift invariance in addition to RSI. It is discussed how these two symmetries can be implemented in models with finite field equations and canonical equal-time commutation relations for fields. (auth)

25950 WOULD-BE LOCAL FIELDS. Hindle, C. M. (Seminar fuer Theoretische Physik, Zurich). Fortschr. Phys.; 19: No. 6, 369-392(1971).

General quantum field theory is formulated for the case when the Wightman distributions can grow in momentum space as the exponential of a covariant polynomial. Appropriate spaces of test functions are introduced, and it is shown that the vacuum expectation values can be written in terms of various associated tempered distributions, which enjoy some of the properties of ordinary Wightman distributions; in particular, they can be represented as boundary values of functions holomorphic in the usual extended tubes. Notions of locality for the tempered distributions can be introduced, which are sufficient to imply the PCT theorem and theorems on the connection between spin and statistic for the non-tempered fields. It is shown how a Haag–Ruelle theory of asymptotic states and fields may be set up. A possible line of generalization is illustrated by the special example of fields of the type $\chi(\Box)\,A(x)$, where A is a tempered field, and χ an entire analytic function of finite exponential order. (auth)

25951 HAMILTONIAN OF THE CUBIC BOSON SELFINTERACTION IN FOUR DIMENSIONAL SPACE TIME. Osterwalder, K. (Eidgenoessische Technische Hochschule, Zurich). Fortschr. Phys.; 19: No. 2, 43-113(1971).

In four dimensional space time a boson field with cubic self-interaction is considered. It is shown, that if a space cutoff function is included in the interaction term, the renormalized Hamiltonian H_{ren} exists as a densely defined symmetric operator. (auth)

25952 METHODS OF QUANTUM FIELD THEORY WITH RAPIDLY INCREASING SPECTRAL FUNCTIONS. Volkov, M. K. (Joint Inst. of Nuclear Research, Dubna, USSR). Fortschr. Phys.; 19: No. 11, 757-782(1971).

A review of the methods of constructing the scattering amplitudes and Green functions in the non-renormalizable quantum field theories with rapidly increasing spectral functions is given. Such theories as the theories with the chiral Lagrangians, those which describe the interactions with gravitational fields and the theories of weak interactions can be taken as examples. Three big groups of these methods are presented here. In particular, these are as follows: construction of the scattering amplitude in x-space (the function F(x)), construction of the scattering amplitude in momentum space (the function $\tilde{F}$ (p)) and definition of the scattering amplitudes by solving the appropriate equations (in x- or p-space). (auth)

25953 CONFORMAL SYMMETRY IN LAGRANGIAN FIELD THEORY. Srivastava, P. P. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro). Notas Fis. Cent. Brasil. Pesqui. Fis.; 19: No. 5, 143-179(1972).

Conformal symmetry in Lagrangian field theory is discussed for Lagrangians with derivatives up to first order. Conditions for "invariance" and "covariance" of the Lagrangian and for expressing the conformal currents as moments of "improved" energy momentum tensor are discussed. (auth)

25954 SIGNAL GEOMETRY IN SPECIAL RELATIVITY. Schuessler, N. A. Chicago; Illinois Inst. of Tech. (1972). 74p. University Microfilms Order No. 73-2797.

Thesis (Ph.D.).

We consider a set Δ of observers in space-time moving with uniform velocity with respect to one another. Each observer is assumed to have a co-ordinate frame with respect to which he is stationary at his spacial origin, and the coordinate frames of any two observers are related by an affine Lorentz transformation (without time reversal) depending upon an initial configuration. The observers send visible light signals to one another, inducing a signal function f_{ij} between each pair of observers i and j. Against the background of the Lorentz transformations, we investigate the structure imposed on this system by the signal functions; that is, we ask not what a particular observer calculates, but what he sees at a particular time. We investigate the phenomenon of collision and the relations of betweenness and direction relative to a fixed observer at a fixed time. The collision of two observers, usually expressed in terms of the coordinate frame of a fixed observer, can be defined equivalently in terms of the signal functions. The relations of betweenness and direction in Δ, which we define in terms of the signal functions, are strongly connected to the co-ordinate frame of the fixed observer and correspond to similar relations in R^3. We introduce $S_{k,t}$, the visual t-space of an observed k at his time t, which we interpret as what k sees at his time t, and we show that $S_{k,t}$ has the linear space structure of R^3. The visual t-space $S_{k,t}$ is obtained by identifying colliding observers, and there are two appropriate topologies for $S_{k,t}$: the Euclidean topology of R^3 and the quotient topology obtained from the topology induced on Δ by the signal functions. We show that these topologies are equivalent. (Diss. Abstr.)

25955 BETHE SUMS FOR LAMB SHIFT CALCULATIONS IN HIGHER EXCITED STATES. Klarsfeld, S. (Institut de Physique Nucleaire, Orsay, France); Maquet, A. Phys. Lett.; 43B: No. 3, 201-203(5 Feb 1973).

Bethe's average excitation energies have been systematically evaluated for all states with $n \leq 8$. (auth)

25956 BEHAVIOR OF ASYMPTOTIC FIELDS UNDER INTERNAL SYMMETRY TRANSFORMATIONS. Rest, J. Milwaukee; Univ. of Wisconsin (1972). 89p. University Microfilms Order No. 73-4415.

Thesis (Ph. D.).

A self-consistent quantum field theory is formulated and its application to dynamical theories which exhibit either exact or approximate Lie group symmetries is investigated. In particular, the quantum field theory developed does not depend on the knowledge of the equal time commutation relations for the interacting fields, but instead derives them. The main computational steps in the self-consistent formulation are illustrated by means of a solvable model, and it is shown that the existence of a bound state is intimately connected with the microcausality requirement. A model possessing approximate SU(3) symmetry is investigated using the self-consistent method, and in this SU(3) model microcausality constrains all renormalization constants to be equal. It is shown that while the interacting fields belong to irreducible representations of the SU(3) internal symmetry group, the physical asymptotic fields transform nonlinearly. Applications of the idea of nonlinear transformations for the physical fields in the form of "weighted linear transformations" are studied in SU(3) for K_{l3} decay and in SU(3) $\otimes$ SU(3) where physical mass sum rules between pseudoscalar and scalar particles are derived. The results obtained are consistent with experiment. (Diss. Abstr. Int., B)

25957 TWISTOR THEORY: AN APPROACH TO THE QUANTISATION OF FIELDS AND SPACE–TIME. Penrose, R. (Birkbeck Coll., London); MacCallum, M. A. H. Phys. Rep.; 6C: No. 4, 241-315(Feb 1973).

Twistor theory offers a new approach, starting with conformally invariant concepts, to the synthesis of quantum theory and relativity. Twistors for flat space-time are the SU(2,2) spinors of the twofold covering group O(2,4) of the conformal group. They describe the momentum and angular momentum structure of zero-rest-mass particles. Space-time points arise as secondary concepts corresponding to linear sets in twistor space. They, rather than the null cones, should become "smeared out" on passage to a quantized gravitational theory. Twistors are represented here in two-component spinor terms. Zero-rest-mass fields are described by holomorphic functions on twistor space, on which there is a natural canonical structure leading to a natural choice of canonical quantum operators. The generalization to curved space can be accomplished in three ways; (1) local twistors, a conformally invariant calculus, (2) global twistors, and (3) asymptotic twistors which provide the framework for an S-matrix approach in asymptotically flat space-times. A Hamiltonian scattering theory of global twistors is used to calculate scattering cross sections. This leads to twistor analogues of Feynman graphs for the treatment of massless quantum electrodynamics. The recent development of methods for dealing with massive (conformal symmetry breaking) sources and fields is briefly reviewed. (auth)

25958 ANALYTICITY IN QUANTUM FIELD THEORY. II. Causality and Dispersion Relations. Rechenberg, H. (Max-Planck-Institut fuer Physik und Astrophysik, Munich); Sudarshan, E. C. G. Contract AT(40-1)3992. Nuovo Cim.; 14A: No. 2, 299-322(21 Mar 1973).

The consequences from causality in high-energy physics are studied, with particular reference to the well-known claim that a strong connection exists between causality and global analyticity of the scattering amplitudes. It is demonstrated that this relation is not as tight as has been conventionally taken for granted, but depends on additional assumptions imposed on the scattering amplitudes in the unphysical as well as in the physical region; at present no experimental test of these extra assumptions can be given. Therefore an attempt is made to discard them and explore a new concept of causality, which assures the usual (covariant) cause-event structure only over macroscopic distances and allows for violations in microscopic regions. Quantum field theory with "shadow states" is examined and found to be consistent with macroscopic causality, though not necessarily leading to the so-called normal analytic scattering amplitudes. (auth)

25959 NEW CONCEPTS OF TIME AND BREAKDOWN OF THE LAW OF CONSERVATION OF MASS AND ENERGY IN NUCLEAR OR STRONG FIELDS. Ayub, S. M. J. Natur. Sci. Math.; 12: No. 1, 7-17(Apr 1972).

Evidence is given showing that if the velocity of light decreases from its value in vacuum to 10^5 cm/sec under certain conditions in strong fields approximating nuclear fields, there arises a situation where the law of conservation of mass and energy would break down and also the concept of the absolute nature of the velocity of light to that extent. The expression $E - mc^2$ would then become $K = m(c - x)^2$. (JFP)

25960 GOLDSTONE'S THEOREM FOR A CLASS OF CURRENTS NOT COVARIANT UNDER TRANSLATIONS. Ferrari, R. (Univ., Pisa, Italy). Nuovo Cim.; 14A: No. 2, 386-402(21 Mar 1973).

A class of currents not covariant under space-time translations is considered. The assumptions about the members of such class are deduced from some general properties of frequently used symmetry transformations, e.g., gauge transformations of second kind and dilatation transformations. In the framework of Wightman field theory Goldstone's theorem is proved, without use of Lorentz covariance and positivity for the metric. (auth)

25961 INVARIANT SCALAR PRODUCTS AND QUANTIZATION OF GENERAL POINCARE-INVARIANT WAVE EQUATIONS. Jayaraman, J. (Univ. of Madras). Nuovo Cim. 14A: No. 2, 343-362(21 Mar 1973).

The question of second-quantizing the recently derived most general types of proper Poincaré-invariant Schrödinger wave equations (employing locally covariant wave functions without redundant components and describing arbitrary-spin particles) is considered. As a prelude to carrying out this program the associated relativistically invariant scalar products (with respect to which the Poincaré group is unitary) are determined. Then it is shown that from amongst the infinity of Poincaré-invariant c-number wave equations just two survive the test of second quantization consistent with the microcausality criterion–one being suitable for half-integer spins alone and the other for integer spins only. The analysis establishes that just the two constraints of proper Poincaré invariance and quantizability lead to the emergence of separate T, C, P invariance (in the case of free-field equations) as well as the correct spin-statistics connection. (auth)

25962 EFFECTIVE REGGE TRAJECTORY IN THE ENTIRE COMPLEX-ANGULAR-MOMENTUM PLANE. Vasavada, K. V. (Purdue Univ., Indianapolis). Lett. Nuovo Cim.; 6: No. 12, 453-458(24 Mar 1973).

Previous attempts to treat effective trajectories by combining poles and cuts have generally been confined to cross-channel trajectories in terms of which the description of scattering in the direct channel at high energies becomes simple. A brief review is first given of the cross-channel effective trajectory ideas. The description is then considered in terms of direct-channel effective trajectories. Implications for the concepts of duality and dual-absorptive models are discussed. (LBS)

25963 RENORMALIZABILITY OF UNRENORMALIZABLE THEORIES. Parisi, G. (CNEN, Frascati, Italy). Lett. Nuovo Cim.; 6: No. 12, 450-452(24 Mar 1973).

The possibility that divergences be present only in perturbation theory but absent in the full solution in the renormalization program of unrenormalizable theories is investigated on the basis that terms like g^a or $g^2 \log g^2$ are present, where g is the coupling constant. The sum of all ladder diagrams for the scattering amplitude in a particular kinematic situation is studied. It is shown that although each diagram in perturbation theory is divergent, a meaning could be given to the sum of all the diagrams: contributions of the form $g^{\delta-D}$ appear in the sum. (LBS)

25964 EQUILIBRIUM OF EXTENDED BODIES IN SPECIAL RELATIVITY. Strnad, J. (Univ., Ljubljana, Yugoslavia). Fizika (Zagreb); 4: No. 4, 251-254(Dec 1972).

The angular momentum law for a point particle can be formulated in the special theory of relativity in two ways: the covariant formulation where the angular momentum and the torque of the particle at event x_μ are defined in respect to the origin O of an inertial frame S; and the noncovariant formulation, based on classical ideas, where the angular momentum and torque are defined in respect to a pivot moving uniformly in frame S. The equilibrium of an extended body is treated according to both formulations and the corresponding results are compared. (LBS)

25965 FUNCTIONAL DESCRIPTION OF SOME NONRELATIVISTIC FIELD THEORIES. II. Tarski, J. (Univ., Paris). Ann. Inst. Henri Poincare, Sect. A; 17: No. 2, 171-194(1972). (In French).

A previous investigation of nonrelativistic (and Euclidean) field theories is continued. The inequalities which are basic for these theories are established. A few properties of the cor-

responding functional integrals and generating functionals are given. (France)

25966 RELATIVITY AND QUANTIZATION. Anastassov, A. H. (Univ., Sofia). Nuovo Cim.; 14B: No. 1, 52-56(11 Mar 1973).

The antagonism between the basic ideas of the theory of relativity and the quantum theory is considered. A way of establishing a continuous-discrete and probability-deterministic theory of space-time and matter is demonstrated. (auth)

25967 CONSTRUCTION OF QUANTUM FIELD FROM MARKOFF FIELDS. Nelson, E. (Princeton Univ., NJ). J. Funct. Anal.; 12: No. 1, 97-112(Jan 1973).

A quantum field on Minkowski space is constructed starting from a Euclidean field. Only the boson case is considered. (JFP)

25968 GENERAL FORM OF CONSTITUTIVE EQUATIONS IN RELATIVISTIC PHYSICS. Lianis, G. (Purdue Univ., Lafayette, IN). Nuovo Cim.; 14B: No. 1, 57-103(11 Mar 1973).

In this study we propose a principle of objectivity which is appropriate to the theory of relativity. The transformation equations of kinematic, thermodynamic and electromagnetic quantities as well as their spatial and temporal derivatives are derived and their objectivity examined. Finally, the restrictions on the form of constitutive equations of continuum physics imposed by the principle of objectivity are studied. (auth)

25969 SOME COMMENTS ON TESTING QUANTUM ELECTRODYNAMICS IN ELASTIC PARTICLE–ANTIPARTICLE SCATTERING. Resnick, L. (Carlton Univ., Ottawa). Can. J. Phys.; 50: No. 24, 3111-3116(15 Dec 1972).

The photon propagator is assumed modified by the addition of a heavy photon of mass M and negative norm, in a conventional way of describing the possible breakdown of quantum electrodynamics. It is noted that, because of interference between direct and annihilation diagrams, a dynamical zero can occur in the physical region of high-energy elastic particle–antiparticle scattering, to lowest order in α. The position of this zero is a function of M. Several reactions are examined with a view to setting limits on M. The elastic scattering of transversely polarized e^-e^+ can be a sensitive probe for a finite M. (auth)

Gravitation and General Relativity

25970 (IC-72/159) CONFORMALLY-INVARIANT MASSIVE SPINOR EQUATIONS. I. Barut, A. O.; Haugen, R. B. (International Centre for Theoretical Physics, Trieste (Italy)). Feb 1973. 20p. Dep. NTIS (U. S. Sales Only) $3.00.

The formulation of the manifest conformally invariant spinor equations with mass term in the six-dimensional space is presented. The six-dimensional space is taken to be the physical space; the additional co-ordinates indicating the scale and scale changes. The minimal dimension of the spin space, where a six vector exists, is eight. The geometry of the spin space, affine and spin connections is discussed and the general spinor equation is established. (auth)

25971 (ITF-72-131-E) SOME APPLICATIONS OF CO-ORDINATE CONDITIONS OF A SPECIAL TYPE IN THE EINSTEIN THEORY OF GRAVITATION. Shirokov, M. F. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1972. 20p. Dep. NTIS (U. S. Sales Only) $3.00.

The possibility of choosing coordinate conditions such as to make equal to zero the four components t_i^μ or $t^{i\mu}$ of the pseudotensor of gravitational momentum and energy, which express the "flux" and "density" of gravitational energy, is shown. It is further shown that the coordinate conditions of this type allows one to prove the following statements: The flux and density of gravitational energy, t_i^μ or $t^{i\mu}$ for any t_i^k or t^{ik} chosen, are physically meaningless not only locally, but globally as well, i.e., at all points of space-time. The integral 4-vector of the gravitational field momentum and energy vacuo, with the Galilean conditions at infinity, is always equal to zero. The material system located in the vicinity of the origin of a coordinate system, where $T_{ik} \pm 0$, is unable either to increase or decrease the energy due to the loss or absorption of gravitational energy only. (auth)

25972 (ITF-72-165-P) SUPPLEMENT TO THE EINSTEIN SPACE CLASSIFICATION. Yakubovich, A. Ya. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1972. 7p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

A supplement is given to the Einstein space classifications obtained previously. (auth)

25973 (ITF-72-166-P) DEGENERATE EINSTEIN SPACES IN GENERAL. Osinovskii, M. E. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1972. 29p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.50.

The topology of some Einstein spaces T_2 and T_3, admitting a group of motions of dimensionality 6 and 3 respectively, is considered. In the first case (the symmetric gravitational field is in vacuo) the group is homeomorphic to R^6 or R^{5*}, the space is homeomorphic to R^4 or R^3T^1. A metric, free of singularities, of the symmetric gravitational field is obtained, and a regular analytic coordinate system in the space is found. In the second case the group is homeomorphic to R^3; the transitivity sets of the group have the some topology, while the space is homeomorphic to R^4. Here a metric, free of singularities, is also obtained, and it is shown that the space may be covered by a single chart $\{\chi^\alpha\}$. (auth)

25974 TRANSVERSE SHIFT BY TOTAL REFLECTION OF A CIRCULARLY POLARISED LIGHT BEAM. Theory and Experimental Proof. de Beauregard, O. C. (Inst. Henri Poincare, Paris). Gen. Relativity Gravitation; 3: No. 4, 391-395(Dec 1972).

The Goos and Hänchen experiments (Ann. Phys.; 1: 333(1947)) have shown that in total reflection the photons tunnel through the second medium (which is taken to be the vacuum), whence a longitudinal shift Δx, Imbert's experiments (Comptes Rendus; 270B: 529(1970)) have shown that if the incident beam is circularly polarized there is also a transverse shift Δz, the sign of which depends on the helicity sign. This new phenomenon is explained, first in terms of a generalized geometrical optics where the velocity and momentum of a spinning photon are noncollinear, then in terms of wave optics, using an appropriate class of solutions of Maxwell's equations. (auth)

25975 COSMOLOGICAL SINGULARITY IN YILMAZ–TUPPER THEORY OF GRAVITATION. Klimek, Z. (Jagellonian Univ., Krakow). Acta Phys. Pol.; B4: No. 1, 153-156(1973).

Some aspects of the early evolution stage of cosmological models based on Yilmaz' theory of gravitation extended by Tupper is described. A possibility of another interpretation of Tupper's extension is also mentioned. Inspection of the obtained equations shows that at radiation era singular solutions cannot exist (this result is completely independent of the cosmical constant and of space-curvature). It seems to be connected with breaking of the energetic condition of the theorems concerning the singularity in cosmology. (auth)

25976 GROUP STRUCTURE AND FIELD EQUATIONS IN EINSTEIN UNIVERSE. Kramer, D. (Univ., Jena, Ger.). Acta Phys. Pol.; B4: No. 1, 11-20(1973). (In German).

The isometric groups of the Einstein universe have two Casimir operators, whose eigenvalue equations are compared with the physical field equations. A discrete spectrum of the energy eigenvalues is given. (tr-auth)

25977 IMBEDDING METHOD OF FINDING THE MAXIMAL EXTENSIONS OF SOLUTIONS OF EINSTEIN FIELD EQUATIONS. Plazowski, J. (Jagellonian Univ., Krakow). Acta Phys. Pol.; B4: No. 1, 49-56(1973).

The problem of obtaining the maximal analytic extension of the solution of Einstein field equations is investigated. A method of finding the maximal analytic extensions by imbedding the corresponding manifolds into a pseudoeuclidean spaces is proposed. The method is demonstrated for the Schwarzschild-like, Reissner–Nordström and Kerr solutions. All extensions obtained are maximal. It is believed that the simplicity of the method will make it useful in physical applications. (auth)

25978 LOCAL STRUCTURE OF SPACE–TIME SINGULARITY AND GRAVITATIONAL COLLAPSE. Liang, E. P. T. (Univ. of Texas, Austin). Lett. Nuovo Cim.; 6: No. 12, 459-463(24 Mar 1973).

Some findings concerning the singularities of static space-times are reported. A pragmatic recipe for constructing the singularities of general space-times is proposed. The bearing of the local singularity structure upon the problem of gravitational collapse is briefly discussed. (LBS)

25979 USE OF THE SCHWARZSCHILD METRIC IN THE KLEIN–GORDON EQUATION. Smith, P. D. P. (Memorial Univ. of Newfoundland, St. John's). Phys. Lett., A; 43A: No. 2, 144(26 Feb 1973).

It is shown that substitution of the Schwarzschild metric tensor into the Klein–Gordon equation predicts the usual perihelion advance of classical general relativity. (auth)

25980 RECURRENT CURVATURE SPACES IN THE GENERAL RELATIVITY THEORY. Grigor'eva, L. B.; Zakharov, V. D. (All-Union Scientific-Research Inst. for Physical Technical and Radiotechnical Measurements, Stantsiya Kryukovo, USSR). Dokl. Akad. Nauk SSSR; 207: No. 4, 814-816(1 Dec 1972). (In Russian).

Four-dimensional pseudo-Riemann space with recurrent curvature K_4 with the signatures +--- was examined. Each of two nonintersecting classes (simple and nonsimple K_n) of spaces K_n applicable to Einstein's theory of gravitation was considered. (KSW)

Scattering Theory

Refer also to abstract 25898.

25981 (ITF-72-170-P) DIFFRACTIONAL SCATTERING IN A THREE-PARTICLE SYSTEM. Polozov, A. D. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1972. 10p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

The process of elastic scattering at high energies in a three-particle system is considered on the basis of integral Faddeev equations. In the high energy approximation a correction to the amplitude of elastic scattering of a particle is found by the bound state of the other two provided that the interaction between the latter is chosen in a separable form. Corrections to the diffractional approximation are estimated. (auth)

25982 (ITF-72-171-P) HIGH-ENERGY APPROXIMATION AND THE FADDEEV EQUATIONS. Polozov, A. D. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fizki). 1972. 14p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

On the basis of Faddeev equations in a diffractional approximation, a formula is obtained for the matrix element of elastic scattering of a particle by the bound state of the other two. The formula takes into account the interaction between them. It is shown that if we ignore this interaction, the contribution of the external energy to double scattering will cancel the sum of higher order terms. Similar formulas were obtained in the case of elastic particle scattering by a three-particle system. The ways of improving the theory are discussed. (auth)

25983 (ITF-72-175-E) ON THE CONVERGENCE OF PERTURBATION SERIES FOR THE S-MATRIX CORRELATION FUNCTIONS IN NONPOLYNOMIAL MODELS AT AN INFINITE EUCLIDEAN VOLUME. Skrypnik, V. I. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1972. 16p. Dep. NTIS (U. S. Sales Only) $3.00.

The problem of convergence of the perturbation series at an infinite Euclidean volume for the boson nonpolynomial models is considered. The existence theorem for the resolvent-type equation at an infinite volume for the S-correlation functions generated by a certain class of nonpolynomial Lagrangians is proved. (auth)

25984 (JINR-E2-6902) BOUND STATES OF THE RELATIVISTIC TWO-BODY PROBLEM IN INFINITE MOMENTUM FRAME. Atanasov, A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 15p. Dep. NTIS (U. S. Sales Only) $3.00.

The bound states of the relativistic two-body problem is discussed in infinite momentum frame. Longitudinal fractions are expressed by the center-of-mass energies of constituent particles. The obtained equation is a quasipotential three-dimensional equation of the Schroedinger type. (auth)

25985 (JINR-P2-6931) EIKONAL APPROXIMATION IN THE QUASIPOTENTIAL TYPE EQUATIONS FOR THE THREE-PARTICLE RELATIVISTIC SYSTEM. Kvinikhidze, A. N. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 27p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.25.

The eikonal approximation is used in the quasipotential type equations for the three-particle relativistic system. Calculations are performed in the momentum representation without taking into account the forms of the pair interaction quasipotentials. The expressions are obtained for the elastic three-particle scattering amplitude and for the amplitude of elementary particle scattered on the weakly coupled bound state. All the iteration terms corresponding to the multiple scattering are taken into account in the derivation. (auth)

25986 (ORO-4317-17) CLASSICAL SCATTERING CROSS SECTION FOR A CUT-OFF COULOMB POTENTIAL. Technical report No. 73-084. MacDonald, W. M. (Maryland Univ., College Park. Dept. of Physics and Astronomy). Mar 1973. 14p. Dep. NTIS $3.00.

The penetration of matter by charged particles and the transport coefficients for ionized gases are often calculated by the method of impact parameters, wherein the Coulomb scattering cross section is set equal to zero for orbits with impact parameters larger than the range of the force. The method does not correspond to a reasonable assumption on the interaction, however, and it is sometimes difficult for students in classical mechanics and plasma physics to accept. It is therefore interesting that the cross section for scattering by a Coulomb force which is zero beyond a certain radius of interaction can easily be calculated by the methods usually presented in junior–senior level courses in classical mechanics. The result provides a simple basis for the method of impact parameters. (1 figure) (auth)

25987 LIGHT-CONE VARIABLES AND THE HIGH ENERGY LIMIT OF ELASTIC SCATTERING. Feldman, G. (Johns Hopkins Univ., Baltimore); Matthews, P. T. J. Phys., A (London); 6: No. 2, 236-246(Feb 1973).

A simple derivation is given of the eikonal approximation for high energy elastic scattering due to the multiple exchange of single scalar particles. This is generalized to the exchange of particles of arbitrary spin or multiple reggeons. The implications for very high energy are discussed. (auth)

25988 SINGLE-PARTICLE SPECTRUM OF THE DUAL-POMERON AMPLITUDE. Alessandrini, V. (Univ. Nacional, La Plata); Amati, D. Nuovo Cim.; 13A: No. 3, 663-678(1 Feb 1973).

The single-particle inclusive spectrum of the dual pomeron amplitude is investigated. Scaling is obtained (if $\alpha_p(0) = 1$) but no pionization if $\alpha_K(0) < 1$. The momentum transverse cut-off turns out to be $\exp[-4k_T^2]$, which is the same as the one obtained from the tree diagrams. An intuitive interpretation of these results is given and the dual amplitude which will be responsible for pionization is indicated. (auth)

25989 GENERAL RESULTS FOR THE INVERSE-SCATTERING THEORY AT FIXED ANGULAR MOMENTUM OR AT FIXED ENERGY. Cornille, H. (Institut de Physique Nucleaire, Orsay, France). Nuovo Cim.; 14A: No. 1, 141-160(1 Mar 1973).

In order to show that inversions at fixed l and at fixed energy are not two disconnected fields of scattering theory, two general results valid in both cases are derived as examples. Moreover, in these two cases the results hold for the Gel'fand-Levitan type of inversion (reconstruction of the Jost solutions). Furthermore, the break-downs of these theories are linked to similar pathological physical features: the presence of ghosts in the k or the l complex planes. (auth)

25990 CONNECTION BETWEEN SMOOTHED AND NARROW-RESONANCE DISCONTINUITIES OF DUAL-RESONANCE AMPLITUDES. Rothe, K. D. (Univ., Heidelberg). Nuovo Cim.; 14A: No. 1, 117-131(1 Mar 1973).

It is shown, for the case of the beta-function and the Bardakci–Ruegg five- and six-point functions, that the high-energy "smoothed" and "narrow resonance" s-channel discontinuities Δ' and Δ are asymptotically equivalent in the sense that in both the Regge and deep inelastic domains $\lim_{n\to\infty} \int_{n-\frac{1}{2}}^{n+\frac{1}{2}} ds\, s^\lambda \Delta / \int_{n-\frac{1}{2}}^{n+\frac{1}{2}} ds\, s^\lambda \Delta' = 1$ for all real λ. (auth)

25991 EIGENPHASES OF THE S-MATRIX AT HIGH ENERGY. Sertorio, L. (Istituto Nazionale di Fisica Nucleare, Rome); Toller, M. Nuovo Cim.; 14A: No. 1, 21-51(1 Mar 1973).

In the spirit of a statistical approach to the S-matrix, the concept of resonant state is discussed and the eigenphase formalism is generalized to many-particle processes. It is shown that the object to be considered is the connected part of the S-matrix at fixed total four-momentum and strong arguments are given in favor of the conjecture that this operator is compact. A generalized eigenfunction expansion is then written. A "structure function" which describes the distribution of the eigenvalues is defined and some of its general properties are studied. Also some consequences of the assumption that the amplitude is dominated by resonances are considered. (auth)

25992 ALGEBRAIC GEOMETRY AND FEYNMAN AMPLITUDES. Cunningham, J. (University Coll. of North Wales, Bangor). Fortschr. Phys.; 19: No. 9, 613-627(1971).

The representation method of obtaining first and second type Landau curves from the Landau criteria is described. The Plucker characteristic analysis of singular curves is outlined and its relationship with the theory of automorphic functions indicated. A differential approach to singularity classification is discussed and a possible extension of the method to obtain asymptotic behavior is conjectured. (auth)

25993 LINEAR SYMMETRIES OF SCATTERING AMPLITUDES. Daboul, J. (Temple Univ., Philadelphia). Fortschr. Phys.; 19: No. 6, 301-367(1971).

If linear symmetries are roughly defined as those symmetries which lead to linear relationships among scattering amplitudes, then the question is raised whether all possible types of linear symmetries are already known or whether there are new types of symmetries which can yet be discovered. It is argued that for an important class of these symmetries there can be no new types of symmetries, except for one which is called scaling symmetry. An attempt is made to point out all types of symmetries which other classes have. In analyzing the above question a simple and consistent formalism is obtained for describing linear symmetries which takes linearity as the starting point for dealing with these symmetries. In this approach all linear symmetries are formally

treated on an equal footing. General results on linear symmetries are derived: These symmetries are then classified into three main classes, and an effort is made to discover the characteristic properties of the individual classes. A number of related topics and examples as listed in the table of contents are also considered. (auth)

25994 SCHUR–PICK–NEVANLINNA INTERPOLATION THEORY: AN ALTERNATIVE TO THE N/D EQUATIONS. Nenciu, G. (Univ. of Copenhagen). Nucl. Phys., B; B53: No. 3, 584-596(12 Mar 1973).

It is pointed out that the Schur–Pick–Nevanlinna interpolation theory is a natural framework for the study of partial-wave dispersion relations. It is an alternative to the usual treatment by N/D equations. Some simple cases are studied in detail. More general problems are briefly touched upon. (auth)

25995 FOURIER–BESSEL EXPANSION OF THE SCATTERING AMPLITUDE AT ZERO MOMENTUM TRANSFER FOR PARTICLES WITH UNEQUAL MASS. Toth, K. (International Centre for Theoretical Physics, Trieste, Italy). Nucl. Phys.; B53: No. 3, 613-633(12 Mar 1973).

The problem of whether a Fourier–Bessel type expansion can be valid at zero-momentum transfer for the unequal-mass scattering amplitude, as a substitute for the Regge–Watson–Sommerfeld representation is investigated. It is shown that the results of a previous paper, giving the solution of the same problem for amplitudes satisfying an unsubtracted dispersion relation can be extended to a class of asymptotically growing scattering amplitudes. In the second part of the paper a Lorentz-pole expansion is outlined, which is valid at arbitrary momentum transfer. The expansion coefficients of this last expansion are expressed by means of the discontinuities of the amplitudes. Finally, a comparison is made between the Fourier–Bessel expansion and the Lorentz expansion. It is argued that, at least as far as the unequal-mass formulas are concerned, it is highly unnatural to assume that a pomeron with intercept $\alpha(0) = 1$ belongs purely to the four-vector representation of the Lorentz group. Rather, it is a mixed object belonging to the four-dimensional and the accompanying infinite-dimensional ones, both characterized by the same Casimir operator eigenvalues. (auth)

25996 SCATTERING THEORY AND SUBDYNAMICS. Mayne, F.; Prigogine, I. (Univ. Libre, Brussels). Physica; 63: No. 1, 1-32(1 Jan 1973).

Recently Prigogine, Henin and George have introduced the concept of subdynamics: the evolution of a dynamical system can be decomposed under very general conditions into independent evolutions taking place in orthogonal subspaces. The aim is to show that for scattering theory in the usual limits of large smooth wave packets, only the evolution in one of the subspaces (II) is relevant. The cases of potential scattering and interacting fields describing stable particles are treated. (auth)

25997 SCATTERING FROM NON-OVERLAPPING POTENTIALS. I. General Formulation. Agassi, D. (Weizmann Inst. of Science, Rehovot, Israel); Gal, A. Ann. Phys. (N. Y.); 75: No. 1, 56-76(Jan 1973).

The problem of scattering from an assembly of nonoverlapping spherical potentials is solved in partial-wave basis for each of the constituent potentials. The resulting scattering operator is a quotient of two infinite matrices and depends on "on-shell" partial-wave amplitudes of the individual potentials. It suggests in general a truncation scheme which essentially considers only those partial waves effective for each collision at the given energy. The multiple-scattering series is recovered, and limiting cases of low energy and high energy are considered. Applications to high-energy scattering of elementary particles by nuclei are briefly discussed. (auth)

25998 OPTICAL POTENTIALS AND EIKONAL APPROXIMATIONS. Williamson, W. Jr. (Univ. of Adelaide). Aust. J. Phys.; 25: No. 6, 643-649(Dec 1972).

An intermediate and high energy scattering approximation is developed by approximating the sum of intermediate states of the target system and expanding the free particle propagator. The resulting expression plays the role of an optical potential and reduces to the eikonal approximation if the average of the excitation energy for the intermediate states is negligible in comparison with the energy of the incident particle. (auth)

25999 EQUIVALENCE OF TWO VARIATIONAL METHODS IN SCATTERING THEORY. Singh, S. R. (York Univ., Downsview, Ont.). Lett. Nuovo Cim.; 6: No. 12, 482-484(24 Mar 1973).

It is shown that the variational method derived by quasi-linearizing the phase equation and the Schwinger variational method are equivalent with a particular identification of the trial function and that one could be derived from the other without any reference to the phase equation. (LBS)

PHYSICS (LOW-TEMPERATURE)

26000 VISCOSITY OF ORTHO AND PARA HYDROGEN MIXTURES. Monchick, L. (Johns Hopkins Univ., Silver Spring, MD); Brown, N. J.; Munn, R. J. Mol. Phys.; 25: No. 2, 249-263(Feb 1973).

The viscosity of ortho-para hydrogen mixtures below 25 K is investigated for a model interaction chosen with an isotropic component that reproduces the high temperature viscosity and virial coefficient data and an anisotropic component inferred from rotation relaxation measurements. The T-matrix elements were calculated with a fast modification of the Numerov method and a close-coupled approximation adapted from the Arthurs-Dalgarno (Proc. R.Soc.A; 256: 540 (1960)) formalism. The model in itself could not explain the viscosity experiments of Becker and Stehl (Z.Phys; 133: 615 (1952)), but, when supplemented by dispersion forces dependent on the rotational state, proved to be satisfactory. (auth)

Superfluidity

26001 CHARGED IMPURITY CONCENTRATION WAVES IN He II AS A TYPE OF SECOND SOUND WAVES. Petru, Z. K. (Univ., Wroclaw). Acta Phys. Pol; A43: No. 2, 287-293(Feb 1973).

The set of conservation laws for the Bose superfluid system with Fermi impurities is derived in exact operator form. The theory of the charge waves phenomenon (waves of a concentration of charged impurities generated by temperature waves) in superfluid helium is presented. A method for its experimental verification is suggested. (auth)

26002 KAPITZA EFFECT IN He I AND He II. Mason, F. C. Columbus, OH; Ohio State Univ. (1972). 112p. University Microfilms Order No. 73-2062.

THESIS (PH. D.).

The Kapitza effect at a copper surface was measured in both liquid helium I and liquid helium II. By using a specially designed conductance cell, with a gap width of only 3×10^{-6} m, to obtain a direct comparison of the thermal boundary resistances in these fluids, it is shown that there is no large scale discontinuity in the Kapitza effect at the He I–He II phase transition. Thus a hitherto unsupported speculation regarding the behavior of the boundary resistance at the transition temperature is verified, and previously reported "indications" of an order of magnitude change at the transition are denied validity. To within the precision of the measurements (1% for smoothed data, 10% point by point) the Kapitza effect is the same in the "normal" liquid phase (He I) as in the "superfluid" phase. (Diss. Abstr. Int., B.)

26003 DYNAMIC PROPERTIES OF NEUTRAL EXCITATIONS PRODUCED IN ELECTRON-BOMBARDED SUPERFLUID HELIUM. Keto, J. W. Madison, WI; Univ. of Wisconsin (1972). 140p. University Microfilms Order No. 73-31,539.

THESIS (PH. D.).

The dynamic properties of the He(2^3S) and the $He_2(a^3\Sigma_u^+)$ atomic and molecular metastable states of helium and the fluorescence of more highly excited molecules produced in electron bombarded superfluid helium were studied. The steady state concentration of $(v = 0)$ $He_2(a^3\Sigma_u^+)$ molecules is shown to be limited by collisions between pairs of these molecules. The rate coefficient for this bilinear destruction mechanism is estimated to be about 2×10^{-10} cm^3/sec at 2.08°K, and it is observed to vary strongly with the temperature in a manner that is roughly inversely proportional to the roton concentration in the superfluid. The bilinear destruction of metastable molecules has been monitored for times as long as 0.1 sec after the initial population of the state, and this establishes a lower bound of 0.1 sec on the radiative lifetime of the $(v = 0)$ $He_2(a^3\Sigma_u^+)$ state in superfluid helium. The lifetime and decay mode of the He(2^3S) atoms are distinctly different from that of the corresponding $He_2(a^3\Sigma_u^+)$ molecule. In particular, the characteristic lifetime of the He(2^3S) state in superfluid helium is essentially independent of the temperature between 2.08 and 1.4°K and is measured to be about 15 μsec. The experimental observations indicate that the destruction of metastable atoms results in the population of high vibrational levels of the $a^3\Sigma_u^+$ molecular state. However, it is shown that the production of $(v = 0)$ $a^3\Sigma_u^+$ molecules responds immediately to the electron beam (response time <3 μsec) and thus the formation of this state in the liquid does not depend upon the destruction of metastable atoms. Despite the fact that the decay modes of the metastable atom and molecule are not related, the production rates for these states are nearly equal and correspond to about 450 and 500 per incident 160 keV electron respectively. The transient decay of the fluorescence of excited helium molecules after a pulse of electron excitation shows that two distinct mechanisms populate the excited molecular states in the liquid. The first mechanism produces a rapid initial decay of the molecular emission which occurs in a time that is of the order or less than 10^{-8} sec. This observation also indicates that some of the radiating states are partially quenched by the surrounding fluid. The second mechanism results in a slowly decaying late afterglow fluorescence of the excited liquid. It is shown that this late time emission is due to the bilinear destruction of the long-lived $He_2(a^3\Sigma_u^+)$ metastable molecules which are produced also in the liquid by the electrons. It is shown further that most of the energy released during these bilinear reactions results in the population of the $He_2(A^1\Sigma_u^+)$ state which subsequently radiates in the vacuum ultraviolet region of the spectrum. The observations also indicate that the $He_2(d^3\Sigma_u^+)$ molecular states which are produced directly by the electron beam interact with a liquid environment which is different than that experienced by the $d^3\Sigma_u^+$ states produced by the bilinear destruction of the metastable molecules. (Diss. Abstr. Int., B.)

26004 PROPERTIES OF A POSSIBLE SUPERFLUID STATE OF ^{3}He. Anderson, P. W.; Varma, C. M. (Bell Telephone Labs., Murray Hill, NJ). Nature (London); 241: No. 5386, 187-189(19 Jan 1973).

It is stated that recent results on anomalies in the pressure-temperature relation and nm^+ nmr line of ^{3}He along the melting curve have stimulated consideration that the much discussed anisotropic superfluid condensation of liquid ^{3}He may in fact be occurring. These results indicate that as the volume is varied continuously in time the curve of pressure against time shows a discontinuous slope at a point A and e "glitch" at a point B, the slope before and after the "glitch" remaining about the same; also at point A the nmr line starts shifting to higher frequencies until point B, and then returns to its unshifted value, but with a reduced intensity. The temperature at point A is estimated at about 3 mK and at point B at about 2 mK. If, as the nuclear resource results show, the first anomaly is associated with the liquid, point A can be interpreted in terms of a second order phase transition in the liquid, and point B as a first order transition. It is shown that a superfluid condensation of liquid ^{3}He must be accompanied by a spin precession of finite frequency due to the dipole-dipole interaction among the ^{3}He nuclei. It is further argued that a second transition may occur into a class for which there is no resonance shift. (UK)

26005 CRITICAL FLUX IN OPEN VERTICAL CANALS FILLED WITH PRESSURIZED SUPERFLUID He. Claudet, G.; Senet, L. (CEN, Grenoble, France). Compt. Rend., Ser. A, B; 275: No. 23, 845-848(6 Dec 1972). (In French).

Heat exchange measurements effected in vertical open channels filled with pressurized superfluid He led to the establishment of two heat flow regimes. An interpretation based on the existence of two critical heat fluxes is given. (auth)

26006 ANALOGY BETWEEN THE THEORY OF SUPERFLUIDITY AND THE THEORY OF DIELECTRICS. Donnelly, R. J.; Roberts, P. H. (Niels Bohr Inst., Copenhagen). Phys. Lett.; 43A: No. 2, 199-200(26 Feb 1973).

It is shown that there is a fruitful correspondence between the properties of dielectrics and the properties of excitations in helium II. (auth)

26007 NEW SOUND MODE IN SUPERFLUID ^{3}He–SUPERFLUID ^{4}He SOLUTIONS. Galasiewicz, Z. M. (Univ., Wroclaw). Phys. Lett.; 43A: No. 2, 149-150(26 Feb 1973).

Assuming the existence of a Fermi-pair condensate in ^{3}He the linearized hydrodynamic equations for ^{3}He–He II solutions are examined and a formula for the velocity of a new sound mode obtained. (auth)

26008 STATISTICAL MECHANICS OF SUPERFLUID MODELS. Singh, K. K. (Univ. of Delhi). Ann. Phys. (N.Y.); 75; No. 1, 38-55 (Jan 1973).

It is shown that the equilibrium thermodynamic properties of some superfluid models can be calculated by using density matrices defined in suitable irreducible representations. The approach enables one to introduce in a fundamental manner temperature-dependent order parameters and can be used to obtain general formulations of the problems of superfluids. (auth)

Superconductivity

Refer also to abstracts 25237, 26653, and 26679.

26009 (COO-3156-53) STRUCTURE AND ENHANCED SUPERCONDUCTIVITY OF EVAPORATED ALUMINUM FILMS. Pettit, R. B. (Cornell Univ., Ithaca, N. Y. Materials Science Center). Aug 1972. 144p. Dep. NTIS $9.25.

Thesis.

The increase in the superconducting transition temperature of evaporated aluminum films is correlated with the average grain size, lattice constant, film thickness, and other structural properties. The transition temperature was determined by fitting the resistive transition to the theory of Aslamazov and Larkin, while the average grain size was determined from the width of the (111) diffraction ring. It was found that the transition temperature is a function of the average grain size with $\ln T_c/T_{c_0} \propto a^{-0.82 \pm .04}$, where a is the average grain size. The approximate 1/a dependence is in agreement with the theories of Harault and Garland et al., as modified by Watton. Both theories indicate that a change in the phonon spectrum at the surface of the grain is responsible for the increased transition temperature. This size dependence is also in agreement with the experiments of Watton. Of the other properties studied, it was found that there is an oxide layer surrounding each grain, as was postulated by others. This structure is determined from high resolution electron microscopy, small angle electron diffraction studies, and changes in the surface plasmon dispersion at small angles. For oxide coated metallic grains, Harault has predicted an enhanced transition temperature inversely proportional to the grain size squared. This behavior is not observed as is indicated by the approximate 1/a dependence discussed above. However, the presence of an oxide layer may influence the magnitude of the observed enhancement. This is indicated by a comparison with the results of Watton. (auth)

26010 (JINR-P8-6863) SOME CHARACTERISTICS OF SPRAYED SUPERCONDUCTING THIN FILMS. Balalykin, N. I.; Muratov, Yu. V.; Rubin, N. B.; Smirnov, Yu. I.; Shabratov, V. G. (Joint Inst. for Nuclear Research, Dubna (USSR)). 1972. 27p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.50.

The problem of preparation of multicomponent films of definite thickness on large surfaces is considered. The results of investigation of superconducting properties of thin films are presented. (auth)

26011 POWDER ROLLED SUPERCONDUCTING COMPOSITE WITH CONTROLLED MORPHOLOGY. Pickus, M. R.; Zackay, V. F.; Parker, E. R.; Holthuis, J. T. (Univ. of California, Berkeley). Int. J. Powder Met.; 9: No. 1, 3-11(Jan 1973).

A procedure is described for producing a superconducting tape by powder metallurgy techniques. Although the superconducting phase, Nb_3Sn, is inherently brittle, it is shown how flexibility is achieved by thermomechanical treatments that cause this phase to occur as interconnected filaments dispersed in a ductile matrix of niobium. (auth)

26012 TWO CONTRIBUTIONS TO THE THEORY OF METASTABLE STATES IN SUPERCONDUCTIVITY. Chou, H.H.Y. Providence; Brown Univ. (1972). 148p. University Microfilms Order No. 73-2249.

Thesis (PH. D.).

The leading terms were determined in the temperature dependence of the superheating critical field ratio $H_{sh}/\sqrt{2}H_c$ in the nearly local region, $1-(T/T_c) \ll K_0^2-(\xi_0/\xi)^3$, just below T_c for $K_0 \gtrsim 0.3$. The higher order nonlinear terms in the generalized Ginzburg–Landau theory and the effective boundary conditions due to surface effects were included. The leading corrections $\epsilon_{sh}^{\beta(1)}$, where $\beta = 1$ for specular reflection and $\beta = \frac{1}{2}$ for diffuse scattering, to the superheating critical field ratio are computed numerically for several values of the Ginzburg–Landau parameter κ between 0.1 to 1, and of the impurity parameter α ($\equiv 0.882\ \xi_0/l$) ranging between 0 to ∞. Resistive fluctuations between metastable quantum states are considered which occur close to T_c in a hollow superconducting cylinder or radius r whose thickness d is small compared to r, λ, and $\xi(T)$. During the analysis, the different roles played by the dimensionless size, $R \equiv r/\xi$, and magnetic coupling, $l_s \equiv r'd/\lambda^2$, parameters were elucidated. The attempt frequencies Ω are determined in the limit $R \to \frac{1}{2}$. (Diss. Abstr. Int., B)

26013 SURFACE SUPERCONDUCTIVITY IN NIOBIUM AND NIOBIUM–TANTALUM ALLOYS. Hopkins, J. R. Ames, IA; Iowa State Univ. (1972). 127p. University Microfilms Order No. 73-3895.

Thesis (PH. D.).

The critical field for surface superconductivity, H_{c3}, and the upper bulk critical field, H_{c2}, were measured as a function of temperature and mean free path for Nb and Nb(Ta) alloys in an attempt to study the spatial variations of the superconducting interaction constant, λ, near a vacuum-metal interface. At temperatures below $T/T_c = 0.85$, the pure Nb sample shows H_{c3}/H_{c2} values well above 1.695 as predicted by Hu and Korenman for the limit of long electronic mean free path. As the mean free path decreases, there is a regular depression of H_{c3}/H_{c2} toward 1.695. At temperatures above $T/T_c = 0.85$, however, there are striking deviations from the theory which may arise because the interaction constant is slightly depressed at the surface. A model calculation by Hu shows that changes in λ at the surface of 0.7% for pure Nb and 1.6% for Nb–1.0% Ta can account for the experimental results. (Diss. Abstr. Int., B)

26014 SUPERCONDUCTING PARAMETERS AND SIZE EFFECTS IN SPHERES, FILMS, AND FOILS OF TYPE I SUPERCONDUCTORS. Maloney, M. D. Providence; Brown Univ. (1971). 182p. University Microfilms Order No. 73-2317.

Thesis (PH. D.).

Experimental determinations are presented of the Ginzburg–Landau (G–L) parameter κ for pure Al, Zn and Cd. From the G–L and BCS theories, in conjunction with the measured thermodynamic critical field, values of the London penetration depth λ_L, the BCS coherence length ξ_0, and the surface energy parameter Δ, were also obtained. Although expected to be ideal, that is, representative of the pure bulk superconducting element, these parameters, and specifically κ, and found to depend upon particular sample conditions. (Diss. Abstr. Int., B)

26015 HIGH FREQUENCY TRANSPORT COEFFICIENTS OF A CLEAN TYPE II SUPERCONDUCTOR NEAR THE UPPER CRITICAL FIELD. de Cerdeira, H.A.G. Providence; Brown Univ. (1972). 116p. University Microfilms Order No. 73-2241.

Thesis (PH. D.).

The attenuation of high frequency longitudinal sound and the electrical conductivity in clean type-II superconductors near the upper critical field, H_{c2} were studied. The approach used is a generalization of that used by Brandt, Pesch and Tewordt to calculate the density of states of a pure type-II superconductor. It is shown that both the attenuation of sound and the electrical conductivity are strongly dependent on mean free path even of $1 > >$. In the low temperature limit simple functional relationships between the transport coefficients, mean free path and magnetic field were obtained. (Diss. Abstr. Int., B)

26016 DISSIPATION OF ENERGY IN A SELF-INTERACTING, MULTIPLY-CONNECTED SUPERCONDUCTING LOOP. Sisemore, L. K. Norman, Ok; Univ. of Oklahoma (1972). 140p. University Microfilms Order No. 73-4968.

Thesis (PH. D).

The "coupled persistatron" is used to detect dissipation of energy in a current-carrying superconducting indium wire. It is found that the point at which dissipation begins can occur at a threshold current which is considerably less than the critical current predicted by Silsbee's hypothesis. The threshold ratio, $S_1 = i_{wc}/i_c$ (i_{wc} being the threshold current at which dissipation is first observed to occur and i_c the critical current predicted by Silsbee's hypothesis from the bulk critical field H_c), is dependent on the diameter of the wire. The macroscopic instability of the superfluid state, that is, the Silsbee violation seems to be peculiar to the azimuthal field created by the wire's transport current. Once the purely superconducting state becomes unstable, dissipation producing fluctuations occur. The rate of dissipation is believed to be determined by defects within the surface layer of the material. The time dependence of the current reapportionment in the coupled persistatron due to dissipation of energy is found to be exponential, the rise time being a function of annealing as well as of transport current. The equilibrium state of the coupled persistatron for a given current apportionment is determined by the threshold current i_{wc} as a function of longitudinally applied magnetic field. (Diss. Abstr. Int., B)

26017 CURRENT DISTRIBUTION IN HOMOGENEOUS TYPE II SUPERCONDUCTING CYLINDER. Takacs, S.; Hlasnik, I. (Electrotechnical Inst., Bratislava). Acta Phys. Pol.; A43: No. 2, 233-235(Feb 1973).

From the earlier calculated magnetic-field distribution in superconducting cylinder under the influence of axial current without external magnetic field, the current distribution is derived and compared with experimental results on PbIn cylinder. (auth)

26018 VARIATIONAL SOLUTION OF GINZBURG–LANDAU FREE ENERGY FUNCTIONAL FOR AN ISOLATED FLUX TUBE. Khanra, B. C.; Raychaudhuri, A. K. (Saha Inst. of Nuclear Physics, Calcutta). pp 13-17 of Proceedings of the Nuclear Physics

and Solid State Physics Symposium, Bombay, February 1–4, 1972. Bombay; Dept. of Atomic Energy (1972).

26019 SUPERCONDUCTING-STATE PARAMETERS USING VARIOUS APPROXIMATIONS FOR DIELECTRIC SCREENING FUNCTION. Rajput, J. S.; Gupta, A. K. (Allahabad Univ., India). pp 25-30 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Bombay, February 1–4, 1972. Bombay; Dept. of Atomic Energy (1972).

26020 SUPERCONDUCTING TUNNELING THROUGH A BARRIER CONTAINING A PAIR OF INTERACTING IMPURITIES. Gupta, H. M.; Upadhyaya, U. N. (Univ. of Udaipur, India). pp 31-34 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Bombay, February 1–4, 1972. Bombay; Dept. of Atomic Energy (1972).

26021 FESTKOERPERTHEORIE. II. Wechselwirkungen. (Solid State Theory. Part II. Interactions). 35p. Madelung, O. Heidelberger Taschenbuecher, Band 109. Berlin; Springer–Verlag (1972). 210p. $4.70.

While the previously published first part discussed particle excitation in solid bodies, the second part analyzes possible interactions between the excited particles. The three most important types of interaction open the door to three great subdivisions of solid state physics: transport, optics, and superconductivity. No completeness is attempted in the treatment of all conceivable phenomena and theoretical models. The discussion is limited furthermore to infinitely large and defect-free solid bodies. Effects associated with lattice distortions, boundary layers, and unordered phases will be the topic of the final third part. The usefulness of group theory is evident for many purposes. Symmetry studies yield qualitative statements about properties of excited particles and significantly facilitate calculations. The appendix contains a brief introduction into the group-theoretical tools for solid state theory and gives examples for their application. (tr-auth)

26022 ANISOTROPY IN THE SUPERCONDUCTING ENERGY GAP OF $NbSe_2$. Clayman, B. P. (Simon Fraser Univ., Burnaby, B. C.). Can. J. Phys.; 50: No. 24, 3193-3197(15 Dec 1972).

The superconducting energy gap in single crystals of $NbSe_2$, a layer structure, was determined to be anisotropic by measuring the far-infrared transmission spectrum. The gap for electron velocities in the layers is $2\Delta_{\perp c} = 2.15 \pm 0.07$ meV and for velocities perpendicular to the layers is $2\Delta_{\parallel c} \approx 1.25$ meV. These results are compared with recent tunneling experiments. (auth)

26023 INTERMEDIATE-STATE STRUCTURES OF SUPERCONDUCTING LEAD. Kirchner, H. Siemens Forsch. Entwicklungsber.; 1: No. 1, 39-44(1971).

A variety of domain structures in superconducting Pb are studied by varying the superconductor thickness systematically in the range 7 to 10^3 μm. A survey of the domain structures is given and the structures are compared with the main theoretical models. In particular, the process of flux branching was examined and both corrugations and partial branching observed. The main feature of branching is confirmed by observations of non-Pb samples by other workers, e.g., Al, Sn, and In. Further experiments of Type-I superconductors with lower surface energy, e.g., Pb–Bi, are recommended. 15 ref. (Metals Abstr.).

26024 CRITICAL FIELDS IN LAYERED SUPERCONDUCTING SYSTEMS. Dobrosavljevic, L. (Inst. of Physics, Belgrade). Phys. Status Solidi (b); 55: No. 2, 773-780(1 Feb 1973).

Layered systems are considered which behave as single but anisotropic superconductors. Supposing a second-order transition in the presence of an external field, the critical fields H_{c2} and H_{c3} in the GL region are calculated. H_{c2} is a function of the angle θ between the magnetic field and the direction perpendicular to the layers; H_{c3} depends on θ in the same way as H_{c2}, the ratio H_{c3}/H_{c2} being the same as in the isotropic case ($H_{c3}/H_{c2} = 1.69$). In the limiting case of thin layers, it is found that H_{c2} is independent of the period of the layered structure, and is larger in the parallel ($\theta = \pi/2$) than in the perpendicular ($\theta = 0$) case. (auth)

26025 PROXIMITY EFFECT IN THREE-LAYER SUPERCONDUCTING SYSTEMS. Gorbonosov, A. E. (Physical-Technical Inst. of Low Temperatures, Kharkov). Fiz. Metal. Metalloved.; 34: No. 4, 714-723(1972). (In Russian).

Current states were examined in spatially nonuniform superconducting systems (SΣS′-contact). Green functions were found for the three-layer system under consideration, as well as the spectrum of the elementary excitations in the Σ layer. The correctness of the model used in the work is discussed, and it is shown that for $d \gg \xi_0$ (2d = thickness of the Σ layer) the corrections for the parameters α and β in the superconducting S,S′, caused by the proximity effect, were so small as to be neglected. (tr-auth)

26026 X-RAY SPECTRAL INVESTIGATION OF SOME SUPERCONDUCTING COMPOUNDS OF VANADIUM WITH THE β-TUNGSTEN STRUCTURE. Dzeganovskii, V. P.; Bondarenko, T. N.; Zhurakovskii, E. A. pp 46-50 of Voprosy Obshchei i Prikladnoi Fiziki. Genkin, Ya. E. (ed.). Moscow; Izdatel'stvo Nauka Kazakhskoi SSR (1972). (In Russian).

From 2nd republic conference on problems in general and applied physics; Alma-Ata, USSR (20 Oct 1969). See CONF-691072-.

The x ray absorption bands and K-edge were obtained for V in silicides and a series of high-temperature superconductors of the type V_3X, where X = Ga, Ge, Sn. The position and intensity of the L-bands were noted. These results were compared with data from quantum mechanical calculations of electron density for compounds of this type. A number of conclusions were reached regarding changes in the d-band structure in high-temperature superconductors and some peculiarities in the band structures. The relative character of the chemical bonds was postulated. (tr-auth)

26027 SPECIFIC HEAT OF SOME UNUSUAL SUPERCONDUCTORS. King, C. N. Stanford, CA; Stanford Univ. (1972). 116p. University Microfilms Order No. 73-4532.

THESIS (PH. D.).

Techniques for measuring the low temperature heat capacity of samples as small as one milligram have been developed. The method requires a fairly strong thermal link between the sample and its surroundings in contrast to the standard techniques which isolate the sample from its surroundings. The calorimeter design and mathematical solutions of the heat flow equations for the experimental configuration are presented. The superconducting properties of the hexagonal rubidium tungsten bronze have been investigated with specific heat measurements on single crystals from 1.5° to 40° Kelvin. The specific heat of rubidium tungsten bronze shows a large "excess" heat capacity over the expected electronic and Debye terms. This "excess" can be described by additional Einstein modes with a characteristic temperature of 57° Kelvin. This "excess" heat capacity does not appear in nonsuperconducting cubic sodium tungsten bronze. It is not apparent from electrical resistivity measurements from 2° to 300° Kelvin that these low energy modes scatter the electron anomalously. Also, the specific heat of acid-etched rubidium tungsten bronze was measured. The data show that the acid treatment raises the bulk transition temperature from 2° to 5° Kelvin. The number of modes associated with the "excess" heat capacity diminishes proportionally to the rubidium concentration in the acid-treated samples. Optical absorption measurements from 0.1 to 3.0 electron volts show anisotropy. The plasma edge occurs at 1.4 electron volts for a c face while there is an additional absorption edge at 2.0 electron volts for the crystal face containing both the c and a axes. Measurements were taken from the heat capacity of small grain-sized (granular) aluminum films from 1.5° to 8° Kelvin. The data show the film to have an enhanced, bulk superconducting transition of 2° Kelvin. The electron density of states at the Fermi surface was, within experimental error, equal to that of pure aluminum. The low temperature lattice specific heat was significantly larger than that of bulk aluminum (the Debye temperature was 306 plus or minus 15° Kelvin for the film as compared to 428 for pure aluminum). This indicates a large increase in the low frequency phonon density of states of small grain-size (approximately 100 Ångstroms) materials. (Diss. Abstr. Int., B.)

26028 DUCTILE SUPERCONDUCTING COPPER-BASE ALLOYS. Tsuei, C. C. (California Inst. of Tech., Pasadena). Science; 180: No. 4081, 57-58(6 Apr 1973).

A new class of ductile superconductors has been prepared by casting and appropriate heat treatments. These alloys superconduct between 4° and 18°K and contain at least 90 atom percent copper and a superconducting phase such as Nb_3Sn or niobium. They can be processed into wires by conventional metallurgical techniques. (auth)

26029 RF IMPEDANCE OF SUPERCONDUCTING WEAK LINKS. Auracher, F.; Van Duzer, T. (Department of Electrical Engineering and Computer Sciences and the Electronics Research Laboratory, University of California, Berkeley, California 94720). J. Appl. Phys. 44: No. 2, 848-851 (Feb 1973).

The rf impedance of a superconducting weak link with negligible capacitance is calculated for a variety of operating conditions. It is shown that the impedance is always real between harmonic steps of the I–V characteristic. The real part of the impedance is negative under certain conditions of bias for small rf signals, thus indicating the region of self-oscillation of the weak link. (auth)

26030 DYNAMIC BEHAVIOR OF JOSEPHSON TUNNEL JUNCTIONS IN THE SUBNANOSECOND RANGE. Zappe, H. H.; Grebe, K. R. (IBM Thomas J. Watson Research Center, Yorktown Heights, New York 10598). J. Appl. Phys. 44: No. 2, 865-874 (Feb 1973).

Transitions from the zero-voltage to the voltage state have been directly measured on large ($\simeq 10^4$ μm^2) Josephson junctions. By adjusting the current load, the switching times (10–90%) were varied from 60 to 400 psec. Good agreement was found between theoretical and experimental results. The times required to transfer current from junctions into superconductive inductances (10^{-11}–10^{-10} H) were also investigated. The switching times ranged from 300 to 550 psec and agreed basically with our simple theoretical model. To explain the details of the voltage developed during current transfer, self-pumped junction resonances had to be invoked. Although these times are expected to be smaller in miniaturized devices, they represent to our knowledge the shortest times ever reported for circuits with a dissipation of less than 10^{-5} W in continuous operation. (auth)

26031 MAGNETIC FIELDS PRODUCED BY A HOLLOW SUPERCONDUCTING CYLINDER AND A COAXIAL SOLENOID. Smith, Todd I. (Departments of Physics and Electrical Engineering, University of Southern California, Los Angeles, California 90007). J. Appl. Phys. 44: No. 2, 852-857 (Feb 1973).

Numerical solutions have been obtained for the magnetic field produced by eddy currents induced in a hollow superconducting cylinder by a centered coaxial solenoid. As the dimensions of the cylinder and the solenoid are arbitrary, the solutions are useful in the design of many types of cryogenic apparatus. The results of studies of the performance of superconducting shields as a function of the length-to-diameter ratio, of the effectiveness of a shield in containing the field of an interior solenoid, and of the use of a superconducting cylinder to homogenize the field produced by a solenoid are discussed. The conclusions apply to all thin-walled conducting cylinders as long as the wall thickness is greater than the skin depth at the frequency of interest. (auth)

26032 HIGH-FIELD SUPERCONDUCTING CURRENT-CARRYING CAPACITIES OF COMPOSITE-PROCESSED V_3Ga TAPES. Tachikawa, K. Y. (National Research Institute for Metals, 2-3-12 Nakameguro, Meguro-ku, Tokyo, Japan); Iwasa, Y. J. Appl. Phys. 44: No. 2, 898-899 (Feb 1973).

Superconducting V_3Ga tapes were produced by fabricating a composite of Cu–Ga alloy and a vanadium core and subsequent heat treatment at 625–800 °C. The critical current of these composite-processed (CP) V_3 Ga tapes was measured at 4.2 K in magnetic fields up to 210 kOe. In CP-V_3Ga tapes, the pronounced "peak effect" appears at fields near 170 kOe where a critical-current density J_c of 1×10^5 A/cm^2 is obtained. At the "peak field", J_c is nearly independent of the thickness d of the V_3 Ga layer. On the other hand, at low fields J_c decreases markedly with increasing thickness. When the Cu–Ga alloy matrix is supplemented by a small amount of manganese, the peak effect disappears consequently improving J_c at lower fields. (auth)

26033 TORQUE STUDIES PERFORMED ON AN ANISOTROPIC SUPERCONDUCTOR: VANADIUM. Genberg, R. W. (Adelphi University, Garden City, N.Y. 11530). J. Appl. Phys. 44: No. 3, 1288-1291 (Mar 1973).

Null-deflection torque magnetometer measurements reveal that the torque on a vanadium single crystal in the Meissner region is consistent with, however in the mixed state is at variance with, that predicted from shape anisotropy considerations. This suggests that in the mixed state for T somewhat near T_c nonlocal effects must be considered and may be the dominant factor in determining the torque on such a specimen. In addition this study reveals a new and sensitive technique for determining the upper critical field and indicates that for T near T_c the torque in the mixed state near H_{c2} is approximately proportional to $H_0(H_{c2}-H_c)$. (auth)

26034 RESIDUAL MICROWAVE SURFACE RESISTANCE OF SUPERCONDUCTING LEAD. Pierce, John M. (Physics Department, University of Virginia, Charlottesville, Virginia 22901). J. Appl. Phys. 44: No. 3, 1342-1347 (Mar 1973).

An extensive experimental investigation aimed at minimizing the residual microwave surface resistance of superconducting lead is described. X-band cavities were made by electroplating lead on copper which had a residual Q as high as 3.7×10^{10}, corresponding to an average residual surface resistance of $3.1\times10^{-8}\Omega$. Electroplating techniques and surface preparation are discussed in detail. Residual resistance due to magnetic flux trapped through the surface was found to have frequency and flux dependence consistent with losses in normal metal exposed at the ends of the flux tubes. It was not necessary to consider flux motion. Loss identified with adsorbed material and surface protrusions was observed as well. Under the best conditions in cavities cooled in ambient magnetic field $<10^{-4}$ Oe, residual resistance of 10^{-8}–10^{-7} Ω remains which varies a factor of 2 or more on temperature cycling. A hypothesis involving thermoelectrically generated trapped magnetic flux is advanced to explain part of this loss, and it is argued that direct phonon generation as suggested by Halbritter and Passow cannot fully explain it. (auth)

26035 CALORIMETRIC INVESTIGATION OF Tl_5Te_3 SUPERCONDUCTIVITY. Haemmerle, W. H.; Reed, W. A. (Bell Laboratories, Murray Hill, New Jersey 07974); Juodakis, A.; C. R. Kannewurf. J. Appl. Phys. 44: No. 3, 1356-1359 (Mar 1973).

The specific heat of several samples in the γ phase of the Tl–Te system were measured between 1.8 and 4.2 °K to determine if the previously reported superconductivity in this phase was a true bulk effect or due to filaments of a second phase. These measurements show a change in the specific heat at T_c of the stoichiometric composition, Tl_5Te_3, which is 60% of the value predicted from the BCS theory. The only second phase present in some samples, as determined by x-ray diffraction, was TlTe; but even as large an amount present as 10% was found to make a very small contribution to the specific heat. Thus we conclude that Tl_5Te_3 is a bulk superconductor, characterized by an electronic specific heat of 5.7×10^{-3} cal/mole deg^2 and a Debye Θ_D of 96 °K. Some possible explanations are proposed to account for the low value of the measured specific heat. (auth)

26036 SCALING LAWS FOR FLUX PINNING IN HARD SUPERCONDUCTORS. Kramer, Edward J. (Department of Materials Science and Engineering, Cornell University, Ithaca, New York 14850). J. Appl. Phys. 44: No. 3, 1360-1370 (Mar 1973).

For all hard high-field superconductors examined to date, there is a maximum in the pinning force density F_p as a function of the reduced magnetic field h. Fietz and Webb first demonstrated in dilute Nb alloys that the peak in F_p scales as $[H_{c2}(T)]^{2.5}$ if the temperature is changed; the maximum value of F_p occurred at the same value of reduced field regardless of temperature. Recent data on the temperature dependence of pinning in Nb_3Sn, Nb–25% Zr and a Nb–Ti alloy, which exhibits the "peak effect", are analyzed to show that similar scaling laws are obeyed by these materials. All presently available evidence indicates however that the reduced field h_p at which the maximum F_p occurs, as well as the height and shape of this maximum, can be altered by metallurgical treatment. Apparently weak pinning defects, or widely spaced ones, produce a small peak in $F_p(h)$ at high h whereas strong closely spaced pins produce a large peak in $F_p(h)$ at low h without producing much change in $F_p(h)$ at high h. A model which predicts these metallurgical effects, as well as the scaling laws, is proposed. According to the model at $h<h_p$, flux motion occurs primarily by unpinning of line pins, whereas at $h>h_p$ it occurs by synchronous shear of the flux line lattice around line pins too strong to be broken. In the high-field regime, where quantitative predictions are possible, the magnitude and field dependence of F_p are in good agreement with experiment. In this model the anomalous "peak effect" occurs whenever line pins are relatively weak, producing a narrow peak in $F_p(h)$ at high h. (auth)

26037 REPULSIVE EFFECT OF LOW FREQUENCY PHONONS ON SUPERCONDUCTIVITY. Allen, P. B. (State Univ. of New York, Stony Brook). Solid State Commun.; 12: No. 5, 379-383 (1 Mar 1973).

The Eliashberg integral equations are investigated to determine the effect of low frequency phonons on the superconducting transition temperature T_c. It is found that phonons of frequency less than T_c are repulsive (diminish T_c) while phonons of higher frequency have a diminished attraction unless the frequency is substantially above T_c. Various implications are discussed concerning observed values of T_c and predicted mechanisms for raising T_c. (auth)

26038 MICROMAGNETIC THEORY OF FERROMAGNETIC SUPERCONDUCTORS. Krey, U. (Univ., Hamburg). Int. J. Magn.; 3: No. 1-3, 65-73(Sep 1972).

A phenomenological theory, which combines and generalizes the Ginzburg–Landau theory and the micromagnetic theory of ferromagnetism, is developed for ferromagnetic superconductors. The thermodynamic potential is written down as a function of the order parameter ψ, direction and magnitude of the local magnetic polarization J, and of the vector potential of the magnetic induction B. The theory is applied to the problems of the isolated flux lines in superconducting ferromagnets, and the possible magnetic domain structures for vanishing external magnetic field. If the correlation length corresponding to the longitudinal magnetic susceptibility is comparable with the penetration depth λ of the magnetic induction, the flux line profiles become damped-oscillatory functions of the radiusvector, and their interaction is attractive. For vanishing external field, a magnetic domain structure with domain diameters as small as 2λ or less can be stable in superconducting ferromagnets, as long as the domain wall width is much smaller than λ. (auth)

26039 INFLUENCE OF A SMALL LATTICE DEFORMATION ON THE SUPERCONDUCTIVE CRITICAL TEMPERATURE OF ALLOYS WITH THE Cu_3Au-TYPE STRUCTURE. Damsma, H.; Havinga, E. E. (Philips Gloeilampenfabrieken, Eindhoven, Netherlands). J. Phys. Chem. Solids; 34: No. 5, 813-816(May 1973).

Lattice dimensions and superconducting critical temperature T_c, of $Ca_{1-x}Sr_xPb_3$ alloys were measured. The Cu_3Au-type cubic structure of $CaPb_3$ becomes tetragonally distorted near x = 0.50. At the same composition a marked increase in T_c is found, which is explained in terms of Brillouin zone effects. (auth)

26040 ISOLATED VORTEX STRUCTURE AND THE LOWER CRITICAL FIELD FOR CLEAN TYPE 2 SUPERCONDUCTORS FAR FROM T_c. Kramer, L.; Pesch, W. (Kernforschungsanlage, Juelich, Ger.). Solid State Commun.; 12: No. 6, 549-552(15 Mar 1973).

The structure of an isolated vortex line and the lower critical field were calculated numerically from Eilenberger's (Z. Phys.; 214: 195 (1968)) version of the Gorkov theory. Results for clean superconductors with κ (the Ginzburg–Landau parameter) between $1/\sqrt{2}$ and 2 and temperatures down to 0.25 T_c are reported and compared with experiment. (auth)

26041 KINETICHESKIE I NESTATSIONARNYE YAVLENIYA V SVERKHPROVODNIKAKH. (Kinetic and non-steady state phenomena in superconductors). Geilikman, B. T.; Kresin, V. Z. Sovremennye problemy fiziki. Moscow; Izdatel'stvo Nauka Glavnaya Redaktsiya Fiziko Matematicheskoi Literatury (1972). 176p.

Transfer phenomena in superconductors and their behavior in alternating fields are examined. Various thermal conductivity mechanisms are compared with experimental data. Problems connecting superconductors with sound absorption, both high frequency ultrasound and low frequency sound waves, anisotropy, thermoelectric effects, thermomagnetic effects, and convective heat conductivity are discussed. 344 references. (KSW)

Equipment and Devices

Refer also to abstracts 25325, 25327, and 26564–26567.

26042 (AD-749986) SUPERCONDUCTING MICROWAVE CAVITIES AND JOSEPHSON JUNCTIONS. Smith, T. I. (University of Southern California, Los Angeles. Dept. of Physics). 31 Mar 1972. Contract N00014-67-A-0269-0011. 23p. NTIS.

The possibility of using very high Q superconducting microwave cavities to obtain a strong coupling between the electromagnetic field and a Josephson junction has prompted a study of such systems. Expressions were obtained describing the dc I–V characteristic of a junction biased so that the Josephson radiation frequency is near a resonance of the cavity in which it is located. The rf power coupled into an X-band (10 GHZ) TE (011) mode cavity from a weakly coupled junction is approximately 3×10 to the 13th power (I_0) squared Q watts, where I_0 is the critical current of the junction and Q is the cavity Q. When the coupling between the junction and cavity is large enough, the I–V characteristic becomes multiple valued and the power coupled to the cavity depends on the state of the system. The maximum power which can be coupled to the cavity is approximately 0.58 I_0 V (dc), where V (dc) is the voltage required to bias the junction to the resonant frequency of the cavity. (auth) (NTIS)

26043 (JINR-P13-6914) LOW-FREQUENCY CIRCUITS WITH SUPERCONDUCTING INDUCTANCE. Vasiliev, B. V.; Simkin, V. G. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1971. 10p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

Low-frequency circuits with superconducting inductance ~0.5 H were described. The Q factor about 1300 and the resonance frequencies of circuits of 23, 59, 144 Hz were obtained for helium temperature. (auth)

26044 (KFK-1699) IRRADIATION EFFECTS IN NbTi MULTICORE SUPERCONDUCTORS. Maurer, W. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Experimentelle Kernphysik). Dec 1972. 12p. Dep. NTIS (U. S. Sales Only).

Irradiation effects in some NbTi multicore superconductors are reported. Critical and take off current changes due to 50 MeV deuteron irradiation at room temperature are investigated. The voltage current characteristic in the resistive region is altered. The measured characteristic is compared with some existing models, and a new empirical formula describing the voltage current dependence in the resistive region is given. The irradiation influence on maximum dissipated power and on stability is investigated. (auth)

26045 (RHEL/R-266) LOW TEMPERATURE THERMAL CONDUCTIVITY APPARATUS AND SOME TYPICAL DATA. Ball, M. T. (Rutherford High Energy Lab., Chilton (England)). Jan 1973. 22p. Dep. NTIS (U.S. Sales Only) $3.25. UK 25 pence.

Apparatus for measuring the thermal conductivity of relatively large specimens in the region 4.2 to 5.0 K is described, and some thermal conductivities are listed. (auth)

26046 MODIFIED CRYOTIP FOR SPECTROPHOTOMETRIC STUDIES. Greenstock, C. L.; Dunlop, I. (Atomic Energy of Canada Ltd., Pinawa, Manitoba). Cryogenics; 13: No. 1, 4-6 (Jan 1973).

To eliminate the bulky liquid nitrogen cooling systems normally used in spectrophotometric studies, a specially modified Cryotip liquefier is used. The modification of the Cryotip is described and its application to low temperature pulse radiolysis measurements. (auth)

26047 MINIMUM CURRENT AND RELATED TOPICS IN JOSEPHSON TUNNEL JUNCTION DEVICES. Zappe, H. H. (IBM Thomas J. Watson Research Center, Yorktown Heights, New York 10598). J. Appl. Phys. 44: No. 3, 1371-1377 (Mar 1973).

Solutions of the equation of motion of Josephson junction devices are approximated by analytical relations in the pronounced nonlinear range of small voltages. The minimum current at which the junction switches back into the net zero voltage state is established for devices with resistive and inductive elements, including the nonlinear tunnel resistance of the junction. The stability of the voltage state is estimated. Conditions for which junctions fail to enter the zero-voltage state are discussed. (auth)

26048 PROCEDURE FOR MANUFACTURING DEVICES FOR THE MEASUREMENT OF VERY LOW TEMPERATURES, THE DEVICES OBTAINED, AND THEIR APPLICATION. Frossati, G.; Thoulouze, D.; Montier, M.; Guernet, J. B. G.; Peccoud, L. (to Commissariat a l'Energie Atomique). French Patent 2,123,179. 8 Sep 1972. Filed date 28 Jan 1971. 14p. (In French).

A procedure for manufacturing devices for the measurement of very low temperatures (<1 deg K) is presented. These devices are very sensitive, accurate, and yield very reproducible results. In these devices the resistance of a certain volume of doped semiconductor material is measured. A surface layer having a well defined doping ion concentration and a well defined thickness is formed on one of the faces of a semiconducting monocrystal. Electrical contacts are formed at the two ends of this region. (auth)

PHYSICS (NUCLEAR)

26049 NUCLEAR RESEARCH REPORT. Compilation of On-Going Research Projects. Volume 2, 1973. Columbus, OH; Nuscience Publications (1973). 216p. $38.00.

The second yearly compilation of nuclear research in progress is presented. Titles of projects are arranged according to country and research center, and authors are listed as well as any necessary descriptors. A subject and author index is provided. A partial listing of high-energy physics projects is included. (JWR)

Neutron Interactions with Matter

Refer also to abstracts 26720 and 27135.

26050 (BNL-17649) INTERACTION BETWEEN THE NATIONAL NEUTRON CROSS SECTION CENTER, THE CROSS SECTION EVALUATION WORKING GROUP, AND THE USER COMMUNITY. Ozer, O. (Brookhaven National Lab., Upton, N. Y.). 1972. 10p. (CONF-730302-6; SM-170/50). Dep. NTIS $3.00.

From Symposium on applications of nuclear data in science and technology; Paris, France (12 Mar 1973).

The primary base of evaluated nuclear data in use in the United States is produced by the cooperative efforts of two groups: The Cross Section Evaluation Working Group (CSEWG) and the National Neutron Cross Section Center (NNCSC), which administers the the former. The CSEWG–NNCSC interaction with each other, the user community, and the funding agencies, as well as the procedures followed in the generation of the ENDF/B files, are examined. Objectives of CSEWG, composition and functions of CSEWG, administration of CSEWG, the data-testing subcommittee, the codes and formats subcommittee, and other subcommittees, as well as goals for the future, are included. (RWR)

26051 (IAE-2018) NEUTRON THERMALIZATION (REVIEW). Mostovoi, V. I. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow. Institut Atomnoi Energii). 1970. 40p. (In Russian). INIS.

The purpose of the review is to give an introduction on the contemporary methods and the results obtained in the area of the experimental investigation of the thermalization of neutrons (illustrated with basic data obtained at the Institute of Atomic Energy) and to draw attention to present difficulties, unresolved questions, and future prospects. (tr-auth)

26052 (JINR-P4-6940) ON THE HEATING OF THE ULTRACOLD NEUTRONS BY THE SOUND VIBRATION OF THE TRAP WALLS. Gerasimov, A. S.; Ignatovich, V. K.; Kazarnovskii, M. V. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Neutron Physics). 1973. 19p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

Heating of the ultracold neutrons (UCN) by the sound vibration of the trap walls is considered. The probability of heating at one collision with the wall and the dependence of the neutron number in the trap on the time are calculated. Possible sources of the sound vibrations and their contribution to UCN heating are considered. (auth)

26053 (LA-5138) DIRECT: A NEUTRON-TRANSPORT CROSS SECTION AND TRIAL-SOLUTION DATA RETRIEVAL SYSTEM. Walters, K. L.; Alcouffe, R. E. (Los Alamos Scientific Lab., N. Mex.). Feb 1973. Contract W-7405-eng-36. 27p. Dep. NTIS $3.50.

The generalized diffusion method for studying transport of particles in a multidimensional system requires extensive cross-section and trial-solution data. Through the use of numerous computer filesets, DIRECT supplies the needed data base, provides software protection for both itself and the data, and eliminates cross-section and trial-solution data tapes. Additional software protection is provided through extensive FORTRAN STOP statements and through fileset manipulation via the control card deck. The master data base can be updated easily through a variety of input options, but only the number and location of individual data sets can be changed. No alterations of any kind are performed on the data sets. (auth)

26054 (LA-UR-73-200) TRANSPORT OF NEUTRONS INDUCED BY 800-MeV PROTONS. Fluharty, R. G.; Seeger, P. A.; Harris, D. R.; Koelling, J. J.; Deutsch, O. L. (Los Alamos Scientific Lab., N. Mex.). 1972. Contract W-7405-eng-36. 16p. (CONF-730302-3). Dep. NTIS.

From Symposium on applications of nuclear data in science and technology; Paris, France (12 Mar 1973).

The Los Alamos Weapons Neutron Research (WNR) facility is described in which 800-MeV protons are used to produce neutron pulses from thick targets of ^{238}U. (WDM)

26055 (ORNL-TM-4072) MONTE CARLO CALCULATIONS AND SENSITIVITY STUDIES OF THE TIME-DEPENDENT NEUTRON SPECTRA MEASURED IN THE LLL PULSED SPHERE PROGRAM. Cramer, S. N.; Roussin, R. W.; Oblow, E. M. (Oak Ridge National Lab., Tenn). Mar 1973. Contract W-7405-eng-26. 239p. Dep. NTIS $14.00.

An extensive calculational study of the LLL pulsed sphere experiments on Fe, N, O, H_2O, ^6Li, and ^7Li is presented. In all the cases which were calculated, except for the water spheres, significant disagreements (>20%) between the calculations and the experiments were uncovered in some energy range. For the iron spheres the disagreement was most severe with the calculations being low by a factor of two to four around 8 MeV. These results indicate that the DNA and ENDF/B-III data files used in the calculations are deficient in some aspects for investigating the transport of 14 MeV neutrons. (WDM)

26056 (RT/FI-(72)48) PRAVDA CODE FOR GENERATING OF EFFECTIVE CROSS SECTIONS. Cecchini, G. P.; Cosimi, M.; Salvatores, M. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 28 Oct 1972. 30p. (In Italian). Dep. NTIS (U.S. Sales Only) $3.50.

The PRAVDA Code for generating effective multigroup composition-dependent cross sections (ABBN type) is described. (auth)

26057 (TUBIK-16) THEORY AND CALCULATION PROGRAMS FOR SOLUTION OF THE NEUTRON TRANSPORT EQUATION ACCORDING TO P_N AND THE DOUBLE P_N METHOD FOR SLAB GEOMETRY. Schumann, U.; Bartsch, G. (Technische Universitaet, Berlin (West Germany). Institut fuer Kerntechnik). 1972. 163p. (In German). Dep. NTIS (U. S. Sales Only) $10.25.

The stationary monoenergetic Boltzmann transport equation is derived for slab geometry. Solutions are given for the case of constant material cross sections and a constant isotropic source distribution using the P_N and double P_N methods with anisotropic scattering included. The characteristic equation of the double P_N-method for linear anisotropic scattering is derived. A method of finding solutions of the transport equation with the respective boundary conditions (Mark and Marshak for the P_N-method) especially for multiplying media, is given in matrix notations. The numerical results of the P_N- and double P_N-method for nonmultiplying media with isotropic scattering and different boundary conditions are compared. The calculations show that both methods are not equally well suited for slabs of arbitrary thickness. The double P_N-method proves to be superior to the P_N-method for very thin slabs. (auth)

26058 (UCRL-51144(Add.)) LIVERMORE PULSED SPHERE PROGRAM: LOW-ENERGY MEASUREMENTS ON CARBON, IRON, AND CONCRETE. Wong, C.; Anderson, J. D.; Brown, P.; Hansen, L. F.; Kammerdiener, J. D.; Logan, C.; Pohl, B. (California Univ., Livermore. Lawrence Livermore Lab.). 17 Jan 1973. 78p. Dep. NTIS $6.00.

The low-energy spectra were measured at 26° at the center of a large enclosure. The pulsed beam frequency was 10 kHz, and the burst and channel width employed are indicated. (WDM)

26059 (UJV-2892-R) ENERGY-DEPENDENT BOLTZMANN EQUATION IN PLANE GEOMETRY. Kyncl, J. (Ceskoslovenska Akademie Ved, Rez. Ustav Jaderneho Vyzkumu). Sep 1972. 22p. Dep. NTIS (U. S. Sales Only) $3.25.

The method of solving the energy–dependent Boltzmann equation is presented. It is proved that the solutions of many transport problems can be expressed as a superposition of the particular solutions of the Boltzmann equation. As example a critical problem for a slab, Albedo, and Milne problems are discussed. Main results are contained in two fundamental theorems. (auth)

26060 (ZJE-132) USING THE METHOD OF SPHERICAL HARMONICS FOR THE CALCULATION OF SHIELDING. PART 1. THE P_n APPROXIMATION. Valenta, V. (Skoda Works, Pilsen (Czechoslovakia). Nuclear Power Construction Dept). 1972. 120p. Dep. NTIS (U. S. Sales Only) $8.00.

An analytical as well as numerical solution of the kinetic equation in the P_n approximation is presented with detailed approxima-

tions P_1, P_2, and P_3 and pertinent boundary conditions, and the technique of multigroup calculations is described. Moreover, the selection of multigroup constants and possible simplifications of the calculations are given. The accuracy of individual approximations is compared. The main attention is given to the elaboration of instructions which are of practical use for numerical methods of solution. (auth)

26061 BOUNDEDNESS OF INTEGRAL TRANSPORT OPERATORS WITH FISSION. Ronen, Y. (Israel Atomic Energy Commission, Beersheba). J. Nucl. Energy; 27: No. 2, 121-122(Feb 1973).

Proof that the integral transport equation is bounded requires assumptions for the case where fission is present in addition to scattering. It is shown that improvement of the proof lies in a better choice of weighting function, i.e., $W_1 = (r,E,\Omega)$. (UK)

26062 NEUTRON THERMALIZATION IN AN INDEFINITE HOMOGENEOUS MULTIPLICATIVE MEDIUM. Bogani, F. (Univ., Florence). J. Nucl. Energy; 27: No. 2, 101-113(Feb 1973).

Existence and uniqueness of the solution of the initial value problem for the Boltzmann transport equation in an indefinite homogeneous multiplicative medium are proved. The existence of at least one real eigenvalue of the transport operator is displayed. Finally, the asymptotic behavior of the neutron density is indicated as $t \rightarrow +\infty$. (auth)

26063 REPRODUCING KERNEL METHOD APPLIED TO TIME DEPENDENT THERMALIZATION. 2. Vanderstraeten, J. J.; Devooght, J. (Univ., Brussels). J. Nucl. Energy; 27: No. 2, 59-70(Feb 1973).

The method of reproducing kernels, developed previously, is used to solve a time dependent thermalization problem. The time dependence associated with the continuous spectrum is given explicitly. (auth)

26064 REPRODUCING KERNEL METHOD APPLIED TO TIME DEPENDENT THERMALIZATION. 1. Devooght, J.; Vanderstraeten, J. C. (Univ., Brussels). J. Nucl. Energy; 27: No. 2, 51-58(Feb 1973).

The formalism of the reproducing kernel method is used to evaluate exponents of bounded operators. Reproducing kernels are built with interpolating properties that take into account any approximate knowledge of the spectrum. The explicit solution of linear evolution equations is reduced to the solution of a few static problems. (auth)

26065 SPECTRAL ANALYSIS OF GRAPHITE PULSED NEUTRON DECAY DATA. Hanna, N. N. (Atomic Energy Commission, Cairo). J. Nucl. Energy; 27: No. 2, 118-121(Feb 1973).

In pulsed neutron experiments diffusion parameters obtained from various experiments for graphite are shown to be inconsistent. By application of a spectral correction analysis technique to graphite measurements obtained from various sources, it is deduced that the disagreement is mainly due to the varying experimental conditions and the spread in density of the graphite used. (UK)

26066 DYNAMICAL NEUTRON DIFFRACTION BY IDEALLY CURVED CRYSTALS. Klar, B. (Institut Max von Laue-Paul Langevin, Grenoble, France); Rustichelli, F. Nuovo Cim.; 13B: No. 2, 249-271(11 Feb 1973).

Neutron diffraction patterns by ideally curved crystals were calculated by extending Taupin's dynamical theory of x-ray diffraction by deformed crystals. The thickness and the curvature of the crystals were utilized as physical parameters. The results of the neutron diffraction calculations are substantially different from those relative to the x-rays. This is due essentially to the low neutron absorption cross section. The main part of the neutron results is physically explained with the aid of the concepts of the dynamical theory of diffraction by perfect crystals. This study finds an application in the design of new types of neutron monochromators. (auth)

26067 SOLUTION OF THE NEUTRON SLOWING-DOWN EQUATION BY INTEGRAL TRANSFORMS. Diaz, M. (Facultad de Ciencias Fisico-Quimico-Matematicas, San Luis, Argentina). Rev. Roum. Phys.; 17: No. 5, 571-579(1972).

Using integral transforms, the "slowing-down density" function χ defined in the age-theory approximation is found. Distinct cases are considered: (i) Medium bounded by a spherical surface, (ii) Medium bounded by two concentric spherical surfaces. In both cases χ depends only on r and on $(r\theta)$, where $(r\theta,\Phi)$ are the usual spherical coordinates. (auth)

26068 THERMALIZATION OF NEUTRONS IN INFINITE HOMOGENEOUS MEDIA. Baikulov, V. A. At. Energ. (USSR); 31: No. 5, 507-508(Nov 1971). (In Russian).

This paper was summarized as paper No. 537/6215 with full copy held by TIC.

A method is discussed for calculating the spectrum of slow neutrons in an infinite homogeneous medium at uniform temperature containing a uniform distribution of fast neutron sources. (WDM)

26069 LEKTSII PO TEORII PERENOSA NEITRONOV. (Lectures on Neutron Transport Theory). Smelov, V. V. Moscow; Atomizdat (1972). 176p.

An introduction to transport theory is offered in an attempt to observe satisfactorily rigorous derivations. The single-velocity theory, methods of solving single-velocity equations of transport, and the fundamentals of the many-velocity theory of transport constitute the major topics of the book. Three appendices elaborate on the method of spherical harmonics for cylindrically symmetrical problems, the method of splitting, and the thermalization of neutrons, respectively. 33 references. (KSW)

Nuclear Properties and Reactions, $A \leq 5$

Refer also to abstracts 25814, 25911, 26093, 26154, 26194, 26229, 26369, and 26394.

26070 (CONF-720404-(Vol.3), pp 1775-1828) REVIEW OF EXPERIMENTAL AND THEORETICAL CONVERSION COEFFICIENTS FOR INNER SHELLS AND NEW EXPERIMENTAL TECHNIQUES. Hamilton, J. H. (Vanderbilt Univ., Nashville); Ramayya, A. V.; Manthuruthil, J. C. Jan 1973.

From International conference on inner shell ionization phenomena and future applications; Atlanta, Georgia, USA (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

The most accurate experimental values of internal conversion coefficients of pure multipole transitions for the K, L, and M shells and subshells are compared with the various theoretical values. These are essentially E2 and M1 transitions. The comparison by Ewbank of the Hager and Seltzer and Sliv and Band calculations is discussed with an emphasis on the regions of large (25 to 100%) differences. Conversion coefficients near threshold electron energies are compared with theory. Information on conversion coefficients of mixed transitions, E1/M2, E2/M1, E1/M2/E3 and higher multipoles ($L \geq 3$) is presented. The effects of penetration into the nuclear volume are included. Finally some of the recent developments in ICC measurements with solid state detectors are discussed. (auth)

26071 (FRNC-TH-285) APPLICATION OF THE SCINTILLATING RECOIL METHOD TO TIME-OF-FLIGHT NEUTRON SPECTROMETRY. Application to the Elastic Scattering of 14.1-MeV Neutrons by Deuterium at Small Angles. de Crespin de Billy, M. 1972. 111p. (In French). Dep. NTIS (U. S. Sales Only).

Thesis.

The differential cross section for the elastic scattering of neutrons in the forward direction ($\theta < 20°$ lab. system) was measured using the scintillation recoil method. The method is based on the supplementary detection of the recoil particle in the scintillating scatterer, and time-of-flight spectrometry. The experimental device and the preliminary measurement made are presented. The total n–d cross section is calculated together with the 14.1-MeV Wick limit from transmission coefficient measurements. The experimental results are compared with the theory. The points obtained are not significant for very small angles; it would have been possible to obtain correct results up to an angle of 10° cm, had smaller detectors and a longer time-of-flight base been used. (FR)

26072 CALCULATION OF THE TOTAL CROSS SECTION OF ND SCATTERING IN THE ENERGY RANGE 20 TO 60 MeV. Komarov, V. V.; Popova, A. M.; Serebryakov, S. G. (Moscow State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 10, 2209-2212(Oct 1972). (In Russian).

The total cross section for nd scattering was calculated from the optical theorem. The amplitude for elastic nd scattering was found on the basis of its representation as contributions of first graphs of an iterated series of diagrams. In the energy region 40 to 60 MeV the amplitude for elastic nd scattering may

be represented as a polar diagram and as a diagram with a single closed contour. The possibility of employing S approximations for describing virtual scattering of two nucleons was investigated. (2 figures) (tr-auth)

26073 CHARGE ASYMMETRY IN THE REACTIONS ^{2}H(d,n)^{3}He AND ^{2}H(d,p)^{3}H. Sergeev, V. A. (Inst. of Nuclear Research, Moscow). Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 10, 2236-2238(Oct 1972). (In Russian).

The contribution of the ^3P_J states to the total cross section, the differential cross section, and the polarization of nucleons were calculated for (d,n) and (d,p) reactions; the splitting both of nucleon and of deuteron states was taken into account. The results for the ^3P_J contributions to the reactions ^{2}H(d,n)^{3}He and ^{2}H(d,p)^{3}H are shown; comparison of these results with experimental data showed that the energy dependence of the charge asymmetry of (d,d) reactions was satisfactorily described (for $E_d < 1.5$ MeV) within the framework of the assumption regarding weakly split (by deuteron J) ^3P_J states with small nucleon widths. (4 figures) (KSW)

26074 SHORT-RANGE CORRELATION CALCULATIONS IN ^{4}He. Iosifescu, M.; Scutaru, H. (Inst. for Atomic Physics, Bucharest). Nuovo Cim.; 13A: No. 3, 583-592(1 Feb 1973).

In the frame of the Jastrow method the possibility of the simultaneous fit of the form factor and of the binding energy for the ^{4}He nucleus is discussed. (auth)

26075 D(p,2p)n REACTION AT 155 MeV FOR HIGH MOMENTUM TRANSFERS AND OFF-MASS-SHELL NUCLEON–NUCLEON INTERACTIONS. Morlet, M.; Frascaria, R.; Marty, N.; Willis, A. (Paris Univ., Orsay, France). J. Phys. (Paris), Colloq.; No. 5, 166 (1972). (In French).

The results of this experiment are compared with theoretical predictions of the L'Huillier model with a view toward testing the off-mass-shell behavior differences for various nucleon–nucleon potentials: Tabakin potential, Hamada–Johnston potential, Pires–de Tourreil potential and Sprung–de Tourreil potential. (FR)

26076 EXCHANGE EFFECTS IN THE ELASTIC SCATTERING OF 140-MeV ALPHA PARTICLES BY ^{3}He. Pugh, H. G.; Frisbee, P. E.; Holmgren, H. D. (Univ. of Maryland, College Park). J. Phys. (Paris), Colloq.; No. 5, 152(1972).

A spin-independent phase-shift analysis including complex phase shifts up to $l = 18$ was performed. Data were fitted with an effective two-body ^{4}He–^{3}He potential including complex and real Woods–Saxon forms and the Majorana exchange operator. (FR)

26077 SOLUTION FOR THE GENERATOR-COORDINATE MODEL OF $\alpha-\alpha$ SCATTERING. Giraud, B.; Hocquenghem, J. C.; Lumbroso, A. (CEN de Saclay, Gif-Sur-Yvette, France). J. Phys. (Paris), Colloq.; No. 5, 63(1972).

The elastic scattering of two α particles is described in the generator-coordinate formalism, the generator coordinate being the average relative distance between the α particles. The formalism developed enables the Hill–Wheeler equation to be solved in the continuum by using only real coordinates. (FR)

26078 SHORT-RANGE CORRELATIONS AND MULTIPLE SCATTERING EFFECTS IN NUCLEON EMISSION INDUCED BY HIGH ENERGY HADRONS. Bleszynski, M.; Malecki, A. (Inst. of Nuclear Physics, Krakow). J. Phys. (Paris), Colloq.; No. 5, 120(1972).

Preliminary results concerning short-range correlations in the ^{4}He(p,2p) reaction are presented. (FR)

26079 COHERENT DISSOCIATION p + ^{3}He → p + d + p AT 600 MeV. Gardes, J.; Fain, J.; Meritet, L.; Querrou, M. (Univ., Clermont-Ferrand, France). J. Phys. (Paris), Colloq.; No. 5, 130 (1972).

The heavy fragment of the ^{3}He → d + p dissociation was detected, and its energy distribution was measured at different angles. This distribution presents peaks at 4 and 8 MeV. (FR)

26080 CROSS SECTION OF THE ^{4}He($\gamma,p\pi^-$) REACTION NEAR THE Δ(1236) RESONANCE. Argan, P.; Audit, G.; de Botton, N.; Laget, J. M.; Martin, J.; Schuhl, C.; Tamas, G. (CEN de Saclay, Gif-sur-Yvette, France). J. Phys. (Paris), Colloq.; No. 5, 131 (1972). (In French).

The $\gamma + {}^4\text{He} \rightarrow p + \pi^- +$ (ppn) reaction was studied in the region of the first Δ(1236) resonance with a view toward comparing the photoproduction of pions on a nucleon of the nucleus with photoproduction on a free nucleon. The kinematic parameters of the reaction were determined. The cross sections measured as a function of the invariant mass Q of the proton–pion system are presented. (FR)

26081 ^{3}He(γ,π^+)^{3}H PHOTOPRODUCTION AND 3-3 RESONANCES. Bachelier, D.; Bernas, M.; Boyard, J. L.; Jourdain, J. C.; Radvanyi, P. (Paris Univ., Orsay, France). J. Phys. (Paris), Colloq.; No. 5, 133(1972). (In French).

Results of measurements of the angular distribution are given as a function of the photon energy at constant q^2 (quadrivector of the momentum transferred to the triton). The first resonance occurs at $E_\gamma = 255$ MeV. (FR)

26082 PHOTODISINTEGRATION OF ^{3}He IN THE Δ(1236) REGION. Argan, P. E.; Audit, G.; De Botton, N.; Laget, J. M.; Martin, J.; Schuhl, C.; Tamas, G. (CEN de Saclay, Gif-sur-Yvette, France). J. Phys. (Paris), Colloq.; No. 5, 139(1972). (In French).

The differential cross section of the $\gamma + {}^3\text{He} \rightarrow p + d$ reaction was measured for photon energies between 200 and 350 MeV and for two values of the deuteron angle in the center-of-mass system (90 deg and 120 deg). (FR)

26083 BREMSSTRAHLUNG IN $\alpha-\alpha$ SCATTERING. Green, A. M. (Univ. of Helsinki); Mueller, R.; Peyer, U. Nucl. Phys.; A203: No. 1, 42-64(1973).

Coplanar bremsstrahlung from $\alpha-\alpha$ scattering is calculated in the equal-angle Harvard geometry with $\theta = 25°$, 30°, and 35° and 6 MeV $\leq E(\text{lab}) \leq$ 22 MeV. This is carried out with the Feshbach–Yennie model, which is also extended to include an additional potential-dependent contribution from the external emission process. Noncoplanarity is also discussed. (17 figures, 15 tables) (auth)

26084 D(p,2p)n AND D(p,pn)p REACTIONS AT 156 MeV. Didelez, J. P.; Goldman, I. D.; Hourany, E.; Nakamura, H.; Reide, F.; Yuasa, T. (Paris Univ., Orsay, France). J. Phys. (Paris), Colloq.; No. 5, 129(1972). (In French).

The 156-MeV D(p,2p)n and D(p,pn)p reactions were simultaneously investigated for a liquid deuterium target; the reactions were identified using coincidence techniques for detecting the proton-1 and the proton-2 (or the neutron). (FR)

26085 PROTON–^{3}He AND p–^{3}H ELASTIC SCATTERING AT 600 MeV. Meritet, L.; Fain, J.; Gardes, J.; Querrou, M.; Pauty, J. F.; Peynet, G.; Vazeille, F. (Clermont-Ferrand Univ., France). J. Phys. (Paris), Colloq.; No. 5, 146(1972).

The experimental cross sections of the elastic scattering of 600-MeV protons by ^{3}He and ^{3}H are presented. (FR)

26086 RADIATIVE n–p CAPTURE. Mosconi, B. (Univ., Florence). Nuovo Cim.; 13A: No. 3, 764-776(1 Feb 1973).

We evaluate the single-particle radiative-capture M1 matrix element in the dispersive approach. With respect to previous calculations by the same method we take into account, in a phenomenological way, the n-p-d vertex structure and not only the deuteron pole, and use a shape-dependent expansion for the singlet phase shifts instead of the effective-range approximation. We consider also the hard-core potential deuteron wave functions. The numerical results confirm the discrepancy between experiment and theory when the exchange current contributions are neglected. (auth)

26087 ^{3}H–^{3}He β-SPECTRUM END POINT ENERGY. On the ^{3}H-^{3}He Ft Value and the PCAC Theory. Bergkvist, K. E. (Inst. for Atomic Physics, Stockholm). pp 307-314 of Symposium on Nucleons and Weak Interactions. Eman, B. (ed.). Zagreb; Institute Rudjer Boskovic (1971).

From Symposium on nucleons and weak interactions; Zagreb, Yugoslavia (Jul 1971). See CONF-710737-.

PCAC theory is studied in nuclei from the ft value of tritium beta decay. For this purpose the end-point energy of this decay is measured with an error of 1 STD not exceeding 15 eV. Also the implication of this measurement with regard to a theoretical calculation of the axial-vector matrix element by Blomqvist is discussed. (JFP)

26088 INTERACTION OF HIGH-ENERGY DEUTERONS WITH NUCLEI IN A MULTIPLE SCATTERING MODEL. Berezhnoi, Yu. A.; Soznik, A. P. (Physical-Technical Inst., Kharkov). Ukr. Fiz. Zh. (Russ. Ed.); 18: No. 1, 29-36(Jan 1973). (In Russian).

On the basis of a multiple scattering model the inelastic processes of interaction are studied for high energy deuterons with light nuclei: deuteron splitting and stripping reaction. Differential and integral cross sections are calculated as examples for different processes of interaction between deuterons and ^{4}He nuclei with 2 GeV energy. (auth)

26089 DELAYED PROTON AND ALPHA PRECURSORS. Hardy, J. C. (Chalk River Nuclear Labs., Ont.). Nucl. Data, Sect. A; 11: No. 4, 327-349(1973).

Data on the decay of observed delayed proton and alpha precursors are summarized in tabular form. For each decay, the listed information includes the precursor half-life, its total available β-decay energy, the separation energy of the particle (proton or alpha) from the emitter, the probability for particle emission, the reactions used experimentally to produce the precursor, identification methods for some precursors, the energies and relative intensities of prominent particle groups emitted in the decay, and a complete reference list. The literature survey was concluded in July 1972. (1 figure, 4 tables) (auth)

26090 EFFECT OF NUCLEAR SYMMETRY IN ^{4}He ON ^{4}He AND ^{3}He ON ^{3}He COLLISIONS AT MODERATE ENERGIES. Dhuicq, D.; Baudon, J.; Barat, M. (Paris Univ., Orsay, France). J. Phys., B (London); 6: No. 1, L1-L3(Jan 1973).

The differential cross section for total scattering in ^{4}He on ^{4}He and ^{3}He on ^{3}He collisions has been measured between 0.25 keV and 3 keV. The effect of the nuclear symmetry in these collisions is studied. The amplitudes and the phases of the oscillations in the cross sections corresponding to ^{4}He atoms (bosons) or to ^{3}He atoms (fermions) are compared. (auth)

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Refer also to abstracts 25425, 25679, 26070, 26089, 26121, 26129, 26130, 26135, 26138, 26146, 26157, 26169, 26220, 26222, 26223, 26280, and 26369.

26091 (CONF-720404-(Vol.3), pp 2013-2029) K-ELECTRON CAPTURE TO POSITRON EMISSION RATIOS IN ALLOWED TRANSITIONS: A CRITICAL ANALYSIS. Fitzpatrick, M. L.; Ledingham, K. W. D.; Gourlay, J. Y.; Lynch, J. G. (Univ. of Glasgow). Jan 1973.

From International conference on inner shell ionization phenomena and future applications; Atlanta, Georgia, USA (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

A review is given of experimental and theoretical work on K/β^+ ratios in allowed decays. (JFP)

26092 (CONF-720404-(Vol.3), 2030-2034) HALF LIFE OF ^{7}Be IN Be_2PO_7 AND IN THE SOLUTION OF $BeCl_2$. Vatai, E.; Ujhelyi, Cs. (Inst. of Nuclear Research, Debrecen, Hungary). Jan 1973.

From International conference on inner shell ionization phenomena and future applications; Atlanta, Georgia, USA (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

The difference of the decay constant of ^{7}Be has been determined for $Be_2P_2O_7$ and Be^{2+} (in 0.1N HCl) as $(18.0 \pm 4.3) \times 10^{-4}$. The corresponding life-times are 53.370 ± 0.040 and 53.462 ± 0.034 days (the errors are standard deviations). It is shown that the differences in capture probabilities are mainly determined by the average number of electrons in the 2s shell. According to the experimental results the variation of this number is small (0.15). (auth)

26093 (FRNC-TH-230) STUDY OF CLUSTER PHENOMENA USING THE REACTIONS INDUCED BY 70- AND 90-MeV α PARTICLES WITH ^{12}C AND ^{14}N. Direct Knock-out Reactions, Spin and Parity of the ^{12}C Levels, Spectroscopic Properties of the M = 4 Nuclei Produced in These Reactions. Jacquot, C. (Strasbourg Univ. (France)). 1971. 140p. (In French). INIS. Thesis.

The interactions of 70- and 90-MeV α particles with ^{12}C and ^{14}N were studied by the nuclear emulsion method; the reaction identification in the emulsion was effected using a computer. The mechanisms were investigated; the probabilities for the different cluster structures in ^{12}C and ^{14}N were determined from the quasi-elastic cross sections. The parameters obtained play the role of physical constants. The $^{12}C(\alpha,2\alpha)$ reaction was specially studied using the α-particle model for ^{12}C. The spin and parity of the ^{12}C excited states decaying to 3α were determined through the Dalitz plot of the $^{12}C(\alpha,\alpha')$ reaction. The levels of the M = 4 nuclei (^{4}He,^{4}Li) produced in the reactions with ^{12}C and ^{14}N were also investigated. (INIS)

26094 (FRNC-TH-278) INVESTIGATION OF THE ^{19}F NUCLEUS BY SCATTERING AND THREE PARTICLE TRANSFER STUDIES WITH THE ^{16}O NUCLEUS. Wery, M. 1972. 145p. (In French). Dep. NTIS (U. S. Sales Only). Thesis.

Investigations of $^{16}O(t,t)^{16}O$ elastic scattering in the framework of the Humblet–Rosenfeld multilevel formalism demonstrated that the 13 to 15 MeV excitation region of ^{19}F is dominated by moderately wide levels often having positive parities and possessing large partial widths (tritons). Studies of the three-particle transfers induced by Li ions in ^{16}O enabled the selectivity of the (^{7}Li,α) and (^{6}Li,^{3}He) reactions to be demonstrated, and also allowed the mirror states of ^{19}F and ^{19}Ne nuclei to be observed. The mechanism of these reactions was studied and an attempt, made to present a macroscopic description for these levels. The results obtained seem to confirm the predictions of the Baz threshold state theory. (FR)

26095 (JINR-P4-6941) MICROSCOPIC MODELS OF GIANT RESONANCES. Jaeger, H-U.; Kissener, G-R.; Eramzhyan, R. A. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 31p. (In Russian). Dep. NTIS (U.S. Sales Only) $3.75.

Excitation and decay of the giant resonance states of light nuclei were considered in the framework of the shell model, with the residual interaction of the nucleons in the nucleus taken into account. (auth) (13 figures, 2 tables)

26096 (ORNL-4864) GAMMA-RAY PRODUCTION DUE TO NEUTRON INTERACTIONS WITH NITROGEN FOR INCIDENT NEUTRON ENERGIES BETWEEN 2.0 AND 20 MeV: TABULATED DIFFERENTIAL CROSS SECTIONS. Dickens, J. K.; Love, T. A.; Morgan, G. L. (Oak Ridge National Lab., Tenn.). Apr 1973. Contract W-7405-eng-26. 65p. Dep. NTIS $3.00.

Numerical values of differential cross sections for gamma rays produced by neutron reactions with nitrogen were obtained for neutron energies between 2.0 and 20 MeV for θ_γ = 90 and 125 deg by using a NaI spectrometer. These data consist of neutron and gamma-ray production group cross-section values of $d^2\sigma/d\omega dE$ for $0.7 \leq E_\gamma \leq 10.5$ MeV, with gamma-ray intervals ranging from 20 keV for $E_\gamma \leq 1$ MeV to 250 keV for $E_\gamma \sim 9$ MeV. Neutron energy intervals varied from 1 MeV for E_n = 2 to 10 MeV to 3 MeV for E_n = 14 to 20 MeV. (auth)

26097 (ORNL-TM-3853) FAST FORWARD NEUTRON PRODUCTION IN THE ^{7}Li(p,n)^{7}Be REACTION FOR 41- AND 64-MeV PROTONS. Wachter, J. W.; Santoro, R. T.; Love, T. A.; Zobel, W. (Oak Ridge National Lab., Tenn.). Mar 1973. Contract W-7405-eng-26. 17p. Dep. NTIS.

Measurements were made by the time-of-flight technique of the neutron energy spectra observed at zero degrees from the ^{7}Li(p,n)^{7}Be reaction using 41- and 64-MeV incident protons. The neutron production cross sections for the fast forward peak (corresponding to excitation of the ground and first excited states of Be) were found to be 33 ± 6 mb/sr at a mean energy of 39 MeV and 36 ± 4 mb/sr at 60 MeV. These results are compared with those reported elsewhere, and the suitability of such ^{7}Li targets as a source of monoenergetic neutrons is discussed. (auth)

26098 (UCRL-51337) EVALUATED NEUTRON-INTERACTION AND GAMMA-RAY PRODUCTION CROSS SECTIONS OF ^{9}Be FOR THE DEFENSE NUCLEAR AGENCY WORKING CROSS-SECTION LIBRARY MAT No. 4154. Howerton, R. J.; Perkins, S. T. (California Univ., Livermore. Lawrence Livermore Lab.). 1 Dec 1972. 15p. Dep. NTIS $3.00.

The methods used to produce evaluated neutron-interaction and photon-production cross sections for the DNA library are discussed. This evaluation is identical with ENDF/B-III MAT 1154 except for the (n,xγ) cross sections associated with the (n,γ) reaction and the energy range, which starts at 0.00001 eV. The evaluated neutron-interaction data were tested by comparison of calculated with experimental parameters of appropriate integral experiments. (1 figure, 2 tables) (auth)

26099 (UCRL-74533) EVALUATED NEUTRON INTERACTION AND GAMMA-RAY PRODUCTION CROSS SECTIONS OF ^{9}Be FOR ENDF/B III MAT. NO. 1154. Howerton, R. J.; Perkins, S. T. (California Univ., Livermore. Lawrence Livermore Lab). 1 Dec 1972. 14p. (CONF-730118-1). Dep. NTIS $3.00.

From Cross section evaluation working group meeting; Upton, New York, USA (Jan 1973).

The methods used to produce evaluated neutron interaction and photon production cross sections for Version III of ENDF/B are discussed. (46 references) (auth)

26100 INTERACTION OF POLARIZED DEUTERONS WITH ^{16}O NUCLEI. Slabospitskii, R. P.; Borovlev, V. I.; Mashkarov, Yu. G.; Deineko, A. S. (Physical-Technical Inst., Kharkov). Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 10, 2225-2227(Oct 1972). (In Russian).

The polarization of deuterons was investigated in elastic scattering by ^{16}O nuclei at E_d = 1.9 to 3.0 MeV and θ_{lab} = 120 and 150°.

The value of the polarization $\langle iT_{11} \rangle$ in the energy interval studied attained ~0.6. The dependence of the vector analyzing power P_d of the reaction $^{16}O(d,p_1)^{17}O^*$ on the energy was evaluated for E_d = 1.8 to 3.0 MeV. (3 figures) (tr-auth)

26101 PHASE SHIFT ANALYSIS OF $\pi^- - ^{12}C$ SCATTERING BELOW 300 MeV. Beiner, J. (Univ., Neuchatel, Switzerland). Nucl. Phys., B; B53: No. 2, 349-365(26 Feb 1973). (In French).

A phase-shift analysis of recent experimental $\pi^- - ^{12}C$ elastic-scattering data is presented. A phenomenological model is used to predict the higher-order phase shifts so as to reduce the number of unknown parameters. Their statistical error is computed. It indicates that certain of these parameters are badly determined. (auth)

26102 SUPER-SELECTIVITY IN HEAVY ION TRANSFER REACTIONS. Scott, D. K.; Hudson, P. N., Fisher, P. S.; Anyas-Weiss, N.; Panagiotou, A. D.; Ellis, P. J.; Buck, B. (Oxford Univ.). J. Phys. (Paris), Colloq.; No. 5, 75(1972).

Multinucleon-transfer reactions have been studied using incident heavy-ion beams of ^{11}B, ^{12}C, and ^{14}N in the region of 10 MeV/nucleon. Data were obtained concerning the transfer of n, p, nn, np, pp, and ppn on light and medium-mass targets. (FR)

26103 HIGH ENERGY PHOTONUCLEAR REACTIONS. David, P.; Debrus, J.; Kim, U.; Luebke, F.; Mommsen, H.; Schoenmackers, R.; Soyez, W.; Speidel, K. H.; Stein, G. (Univ., Bonn). J. Phys. (Paris), Colloq.; No. 5, 18(1972).

Experimental results concerning bremsstrahlung-induced reactions with stable nuclei are presented: high-energy photofission of ^{197}Au and ^{238}U between 0.8 and 2.2 GeV; (γ,p), (γ,d), (γ,t), $(\gamma,^3He)$, and $(\gamma,^4He)$ reactions at 450 MeV on ^9Be, ^{10}B, ^{12}C, ^{27}Al, ^{28}Si, ^{51}V, ^{59}Co, ^{181}Ta, ^{197}Au, and ^{238}U. (FR)

26104 SPECTRA OF NEUTRONS EMITTED IN MUON CAPTURE. Hill, L. L.; Uberall, H. J. Phys. (Paris), Colloq.; No. 5, 168(1972).

The results of a calculation of neutron spectra after muon capture in ^{16}O and ^{40}Ca, obtained with the help of a Brown-type particle–hole model for the giant resonance in closed-subshell nuclei, are presented. (FR)

26105 EXCHANGE TERM MEASUREMENT USING THE COMPLETE ANGULAR DISTRIBUTION FOR 166-MeV α PARTICLE SCATTERING ON ^6Li. Bachelier, D. (Paris Univ., Orsay, France); Bernas, M.; Boyard, J. L.; Jourdain, J. C.; Radvanyi, P.; Roy-Stephan, M.; Devries, R.; Harney, H. L. J. Phys. (Paris), Colloq.; No. 5, 153(1972). (In French).

The angular distribution obtained for the 66-MeV $^6Li(\alpha,\alpha)^6Li$ reaction is divided into two parts: the forward-angle part is explained using the optical model; the backward-angle part corresponds to the α exchange (double nucleon pick-up by the incident α particle). (FR)

26106 SCATTERING OF 139-MeV ALPHA PARTICLES BY ^{12}C. Tibell, G.; Cowley, A. A.; Goldberg, D. A.; Pugh, H. G.; Reichart, W.; Smith, S. M.; Wall, N. S. (Univ. of Maryland, College Park). J. Phys. (Paris), Colloq.; No. 5, 150(1972).

The differential cross sections were measured for the elastic and inelastic scattering of 139-MeV α particles by ^{12}C to the ground state and the 4.44-MeV(2^+), 7.65-MeV(0^+) and 9.63-MeV(3^-) states over an angular range from 3.5 to 57.5° (lab.). The cross sections were also measured for the $(\alpha,^3He)$ stripping reaction leading to the 3.85-MeV($5/2^+$) state and the ($1/2^-$) ground state of ^{13}C. (FR)

26107 QUASI-FREE SCATTERING TO UNBOUND STATES. Lipperheide, R.; Wille, U. (Hahn–Meitner-Institut fuer Kernforschung, Berlin). J. Phys. (Paris), Colloq.; No. 5, 119(1972).

The cross sections for the $^{12}C(p,2p)$ and $^{16}O(p,2p)$ reactions at 460 MeV were calculated in the framework of a model which explicitly takes into account nucleon–nucleon correlations and particle decay of the residual nucleus. (FR)

26108 SOME ^6Li AND ^7Li REACTIONS INDUCED ON GASEOUS TARGETS. Bassani, G.; Foti, A.; Gerardin, C.; Saunier, N.; Wery, M. (CEN de Saclay, Gif-sur Yvette, France). J. Phys. (Paris), Colloq.; No. 5, 68(1972).

Preliminary results are given concerning some $(^7Li,t)$, $(^6Li,d)$ and $(^6Li,t)$ reactions induced on ^{14}N, ^{15}N and ^{16}O at an incident energy of 30 MeV, using a Li^{+++} beam; indications on the position of many-particle states can be deduced up to excitation energies of 20 MeV. (FR)

26109 QUANTITATIVE STUDY OF THE ^6Li INDUCED MULTI-NUCLEON TRANSFER REACTIONS. Bassani, G.; Devries, R. M.; Foti, A.; Pappalardo, G.; Saunier, N. (CEN de Saclay, Gif-sur-Yvette, France). J. Phys. (Paris), Colloq.; No. 5, 69(1972).

A quantitative determination of the relative importance of the compound nucleus mechanism and direct mechanism in $^{12}C(^6Li,d)^{16}O$, $^{12}C(^6Li,t)^{15}O$ and $^{13}C(^6Li,t)^{16}O$ reactions ($E(^6Li)$ = 28 MeV) is presented. (FR)

26110 ANGULAR MOMENTUM EFFECTS FOR $^{16}O + ^{16}O$ SCATTERING STUDIED VIA THE REACTION CHANNELS. Robner, H. H.; Hinderer, G.; Weidinger, A.; Eberhard, K. A. (Univ., Munich). J. Phys. (Paris), Colloq.; No. 5, 42(1972).

An angular momentum-dependent absorption was used in the optical-model potential in view of reproducing the anomalous gross structure which appears in the $^{16}O + ^{16}O$ excitation functions. (FR)

26111 RESONANCE EXCHANGE SCATTERING OF HEAVY IONS AT LOW ENERGY INCLUDING EXCITATIONS. Becker, F.; Beccaria, C. (CNRS, Strasbourg). J. Phys. (Paris), Colloq.; No. 5, 45(1972).

The exchange scattering reaction $\alpha + ^7Li$ was studied. The two channels are coupled by the $l \cdot s$ interaction. The molecular orbitals are obtained using a linear combination of the nuclear orbitals. (FR)

26112 PEAR-SHAPED (NUCLEUS + α)-STRUCTURES IN LIGHT NUCLEI. Friedrich, H.; Huesken, H.; Weiguny, A. (Univ., Muenster, Ger.). J. Phys. (Paris), Colloq.; No. 5, 85(1972).

A pear-shaped intrinsic structure corresponding to an $(^{16}O + \alpha)$-configuration is established for the ground state of ^{20}Ne by using parity-projected variational wave functions. In a plane configuration of ^{16}O, both the positive- and negative-parity states are also pear-shaped intrinsic states corresponding to $(^{12}C + \alpha)$-configurations. (FR)

26113 REACTIONS OF 4 MeV DEUTERONS WITH ^{12}C NUCLEI. Sandin, E. V. Jr. Storrs, CT; Univ. of Connecticut (1972). 121p. University Microfilms Order No. 72 32,164.

Thesis (PH. D.).

Angular distributions for the reactions $^{12}C(d,d)^{12}C$, $^{12}C(d,p_0)^{13}C$, $^{12}C(d,p_1)^{13}C$, $^{12}C(d,p_2)^{13}C$, $^{12}C(d,p_3)^{13}C$, and $^{12}C(d,\alpha_0)^{10}B$ reactions were studied at a deuteron energy of 4.04 MeV using solid state detectors. The $^{12}C(d,\alpha_0)^{10}B$ distribution and absolute cross section values for the $^{12}C(d,p_1)^{13}C$ distribution have not been reported previously. The deuteron energy used is in the region of the pronounced resonance attributed to the 13.71-MeV level of the compound nucleus, ^{14}N, so that strong compound-nucleus effects were expected. However, it was found that a previously calculated optical model curve fits the elastic scattering distribution with little, if any, compound elastic contribution evident. The portion of this curve obscured by interference from the $^{12}C(d,p_g)^{13}C$ reaction was measured by counting the recoiling ^{12}C nuclei. An upper limit for the $^{12}C(d,pn)^{12}C$ reaction was set at 20 mb/sr, although an uncertainty of a factor of 2 to at most 5 must be included since the determination is model dependent. (Diss. Abstr. Int., B)

26114 CALCULATION OF ^{12}C NUCLEAR BINDING ENERGY WITH CONSIDERATION OF THE RADIUS OF REPULSIVE CORE AND THE COULOMB INTERACTION. Tuskiya, V. G.; Chilashvili, G. A. (Tbilisi State Univ., USSR). Soobshch. Akad. Nauk Gruz. SSR; 69: No. 1, 45-48(Jan 1973). (In Russian).

The binding energy of ^{12}C was calculated on the basis of the α-particle model. A nonlocal separable potential was considered to be the interaction potential which caused the repulsion of α particles at small distances and the Coulomb interaction. As expected, the binding energy decreases due to the Coulomb interaction. The binding energy dependence on the repulsive core radius during the Coulomb interaction was considered. (2 tables) (auth)

26115 ENERGY SHIFTS OF GROUND-STATE ROTATIONAL BANDS IN ^9Be AND ^9Be. Kumar, N. (International Centre for Theoretical Physics, Trieste, Italy). Lett. Nuovo Cim.; 6: No. 6, 224-226(10 Feb 1973).

It has recently been observed, by carrying out effective interaction shell-model calculations, that the energies of normal-parity levels of 1p-shell nuclei cannot be fitted well with a single set of interaction parameters. To achieve a good fit, either A = 6 and 7 or A = 8 nuclei had to be omitted. Barker (1966) observed, by carrying out intermediate-coupling shell-model calculations, that, if the data in the lighter nuclei of the 1p-shell are fitted with different sets of interaction parameters, the parameters change appreciably between nuclei of mass numbers 7 and 8. In order to look into the cause of this, Telmi-type effective-interaction shell-model calculations were carried out for the nuclei of mass numbers 6 to 9. (W.D.M.)

26116 EVIDENCE FOR ASSIGNMENT OF 14.0 MeV STATE IN ^{11}B FROM ^{10}B(n,n)^{10}B. Cox, J. M.; Knox, H. D.; Lane, R. O.; Finlay, R. W. (Ohio Univ., Athens). Nucl. Phys., A; A203: No. 1, 89-96(1973).

The differential cross section and polarization for neutrons scattered from ^{10}B were measured at E_n = 2.63 MeV (E_x = 13.85 MeV). The results of this experiment and other available neutron scattering data in the range $1 < E_n < 4$ MeV are interpreted through a single-level R-matrix calculation over the region $12 < E_x < 15$ MeV. Based on this analysis, the most probable J^π assignment for the 14.0-MeV level in ^{11}B is $11/2^+$. The anomaly near E_x = 13.1 MeV can be explained only in terms of two overlapping levels having assignments of $(5/2,7/2)^-$ and $(3/2,5/2,7/2)^+$. (auth)

26117 RESONANCES IN ^{18}O(p,p)^{18}O FOR E_p = 3.4 to 6.2 MeV. Orihara, H.; Rudolf, G.; Gorodetzkii, P. (CRN, Strasbourg). Nucl. Phys., A; A203: No. 1, 78-88(1973).

The excitation function for the ^{18}O(p,p)^{18}O reaction was investigated for E_p = 3.4 to 6.2 MeV at lab angles of 60°, 72°, 87°, 100°, 122°, 139°, and 168°. By using R-matrix theory, parameters of 20 resonances were obtained. The resonances at E_p = 5.13 and 6.06 MeV seem to correspond to the isobaric analogs of the 5.45- ($J^\pi = 3/2^+$) and 6.28-MeV ($J^\pi = 7/2^-$) states in ^{19}O. (7 figures, 2 tables) (auth)

26118 GAMMA NEUTRINO CORRELATION IN MUON CAPTURE IN ^{19}F. Hock, G.; Oziewicz, Z. (Univ., Wroclaw). Acta Phys. Pol.; B4: No. 1, 43-48(1973).

The ratio of the two amplitudes describing completely each of the transitions ^{19}F(g.s., $1/2^+$) $\xrightarrow{\mu}$ ^{19}O($1/2^+$)$_{1,2}$ is studied. For the three transitions ^{19}F(g.s., $1/2^+$) $\xrightarrow{\mu}$ ^{19}O($3/2^+$)$_{1,2,3}$ the gamma-neutrino directional correlation and circular polarization of nuclear gamma rays are calculated. All calculations were performed in shell model intermediate coupling with configuration mixing. (auth)

26119 PARITY-FORBIDDEN α-PARTICLE DECAY FROM THE 8.87 MeV 2^- STATE IN ^{16}O. Waeffler, H. (Max-Planck-Inst. for Chemistry, Mainz). pp 161-180 of Symposium on Nucleons and Weak Interactions. Eman, B. (ed). Zagreb; Institute Rudjer Boskovic (1971).

From Symposium on nucleons and weak interactions; Zagreb, Yugoslavia (Jul 1971). See CONF-710737-.

The width of the parity-violating alpha particle transition from the 8.87-MeV 2^- state in oxygen-16 was measured. (JFP)

26120 FORM FACTOR FOR THE 4.43-MeV LEVEL OF ^{12}C. Gul'karov, I. S.; Masagutov, T. F.; Umarov, G. Ya. (Tashkent Polytechnic Inst.). Izv. Akad. Nauk Uzb. SSR, Ser. Fiz.-Mat. Nauk; No. 4, 55-58(1972). (In Russian).

Data on the inelastic scattering of electrons from the excited 4.43-MeV (2^+) level of the ^{12}C nucleus were compared with form factors which were calculated from the phenomenological Khelm model and the Tass hydrodynamic model. The distribution of the transition density of the nuclear charge in the case of the hydrodynamic model was selected in view of the random distribution of the nuclear charge density in the ground state. A comparison of the theory with the experimental data showed that a reasonable description of the data (in the case of the hydrodynamic model as far as a diffraction minimum) was achieved at certain reduced parameters which characterized a transition density. Values obtained for the transition probability agreed well with current data. (tr-auth)

26121 STUDY OF THE NEUTRON PLUS ^{12}C SYSTEM USING THE UNIFIED-REACTION FORMALISM. I. Elastic Scattering. Leung, T. T. (Aerospace Research Labs., Wright-Patterson AFB, Dayton, OH); Koshel, R. D. Ann. Phys. (N. Y.); 75: No. 1, 132-155(Jan 1973).

A consistent application of Feshbach's unified-reaction formalism is applied to the neutron plus ^{12}C system. A collective model is used for the ^{13}C system. Calculations of the differential cross sections, polarization, and level structure are presented. (10 figures, 2 tables). (auth)

26122 HEAVY ION NOISE. Charles, P.; Dost, M.; Fernandez, B.; Gastebois, J.; Lee, S. M. (CEN de Saclay, Gif-sur-Yvette, France). J. Phys. (Paris), Colloq.; No. 5, 113(1972).

The difference between the α spectra obtained in the ^{14}N + ^{14}N and ^{16}O + ^{12}C reactions is explained, the density of levels of the residual nucleus being taken into consideration. (FR)

26123 ELASTIC-SCATTERING EXCITATION FUNCTIONS FOR THE ^{12}C + ^{12}C SYSTEM. Reilly, W.; Wieland, R.; Gobbi, A.; Sachs, M. W.; Maher, J.; Siemssen, R. H.; Mingay, D.; Bromley, D. A. (Yale Univ., New Haven). Nuovo Cim.; 13A: No. 4, 913-922(21 Feb 1973).

The elastic scattering of ^{12}C ions by ^{12}C target nuclei was studied in the center-of-mass energy range between 13.5 and 37.5 MeV at energy intervals of 250 keV, and at center-of-mass angles of 50°, 60°, 70°, 80°, and 90°. Marked structure was found in these excitation functions: a gross structure with characteristic width ~3 MeV, and a structure with intermediate width systematically increasing from ~200 keV to ~1.5 MeV in the energy range studied. The experimental energy resolution in use was not adequately high to resolve very fine statistical fluctuation structure if present. (5 figures) (auth)

26124 COMPARATIVE STUDY OF THE ELASTIC SCATTERING IN THE ^{12}C, ^{14}N, AND ^{16}O IDENTICAL-PARTICLE SYSTEM. Reilly, W.; Wieland, R.; Gobbi, A.; Sachs, M. W.; Bromley, D. A. (Yale Univ., New Haven). AT(11-1)-3074. Nuovo Cim.; 13A: No. 4, 897-912(21 Feb 1973).

Elastic scattering excitation functions for ^{14}N on ^{14}N (partially obtained with a new heavy-ion gas target system) are reported for center-of-mass angles of 50°, 60°, 70°, 80°, and 90° in the energy range $17 \leq E_{c.m.} \leq 30$ MeV. Comparative optical-model analyses of the ^{16}O–^{16}O, ^{14}N–^{14}N and ^{12}C–^{12}C data have been carried out; the dependence of the calculated cross sections on the model parameters was studied systematically. Ambiguities in the optical-potential parameter determinations were also investigated. The extracted Wood–Saxon parameters are tabulated. (9 figures, 1 table) (RWR)

26125 STUDY OF THE ENERGY LOSS SPECTRA IN THE (p,2p) REACTION IN ^{12}C WITH GLAUBER'S THEORY. Guardiola, R.; Pascual, P. (Univ., Barcelona). Nuovo Cim.; 14A: No. 1, 132-140(1 Mar 1973).

The energy loss spectra of protons in the reaction ^{12}C(p,2p)^{11}X, where ^{11}X can be B($3/2$), B($1/2$), Be($3/2$) and Be($1/2$), are studied in the framework of Glauber's theory. A possible reaction mechanism is discussed. (1 figure) (auth)

Nuclear Properties and Reactions, 20 ≤ A ≤ 38

Refer also to abstracts 25679, 26070, 26089, 26091, 26102, 26103, 26112, 26139, 26154, 26156, 26159, 26166, 26189, 26202, 26207, 26220, 26222, 26223, 26229, and 26369.

26126 (CONF-720404-(Vol.3), pp 1965-1986) M/L ORBITAL ELECTRON CAPTURE RATIOS. Genz, H. (Georgia Inst. of Tech., Atlanta). Jan 1973.

From International conference on inner shell ionization phenomena and future applications; Atlanta, Georgia, USA (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

It has been pointed out that only with precision measurements of allowed M/L orbital electron capture ratios at low Z (≤36) can one distinguish which of the various current sets of electron wave functions and which of the various approaches to the calculation of the electron exchange-atomic overlap correction factors best agrees with experiment. In this review, all available precision values of allowed M/L capture ratios are discussed. The recent improvements in the experimental techniques are surveyed. A critical comparison between results for P_M/P_L, the ratio of the allowed M/L capture probabilities, and theoretical calculations is included containing different sets of wave functions and recent improvements in the exchange correction factor. It is found that the agreement between experiment and exchange-corrected theory for M/L capture ratios has been improved, and that especially for the decays of the three low-Z nuclides, ^{37}Ar (Z = 18), ^{55}Fe (Z = 26), and ^{71}Ge (Z = 32), the experimentally obtained M/L capture ratios agree within the error limits with theoretical predictions using the wave functions of Watson and Freeman and the exchange correction factor of Vatai, also based on the Watson-Freeman wave functions. (auth)

26127 (FRNC-TH-336) UTILIZATION OF THE BLOCKING EFFECT IN A MONOCRYSTAL TO MEASURE THE LIFETIME OF THE EXCITED COMPOUND ^{31}S NUCLEUS. Rousset, C. (Paris Univ., Orsay (France)). 1972. 85p. (In French). Dep. NTIS (U. S. Sales Only) $6.25.

Thesis.

The lifetime of the ^{31}S compound nucleus obtained by irradiating a monocrystal of ^{28}Si with an 8-MeV ^{3}He beam was determined from observations of the distortion occurring in the blocking effect (the distortion due to the lifetime is correlated with the recoil distance of the compound nucleus beyond its lattice site before

charged-particle-emission deexcitation). The Si sample possesses a diamond-type face-centered-cubic structure. The axes and planes are located by their Miller indices. The blocking effect occurring along the most densely packed axes, i.e. ⟨110⟩, was studied. The reaction is highly exothermic (Q_0 = 12.45 MeV), and a large amount of excitation energy is consequently supplied to the compound nucleus. The excitation function of the reaction was determined from a theoretical calculation based on the optical model. An ABACUS program was used, the predicted cross section being of the order of 690 mb. A theoretical calculation made using statistical theory gave a lifetime of 6×10^{-20} sec. A semi-empirical calculation made using the Ericson fluctuations gave a value of 3×10^{-20} sec. The experimental values lie between 10×10^{-18} and 40×10^{-18} sec. Open deexcitation chains of ^{31}S (E_{exc} = 20 MeV), the possible residual nuclei, and the probabilities of their occurrence were studied. The principle behind the measurements remains valid. The experimental errors are believed to arise from the use of a junction localization in the observation of the blocking effect. (FR)

26128 MECHANISM OF THE ^{28}Si + d REACTION WITH A POLARIZED DEUTERON BEAM. Borovlev, V. I.; Deineko, A. S.; Klyucharev, A. P.; Mashkarov, Yu. G.; Slabospitskii, R. P. (Physical-Technical Inst., Kharkov). Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 10, 2228-2231(Oct 1972). (In Russian).

The vector analyzing power of the (d,p) reaction, P_d, was studied for the proton groups p_0 and p_1. The measurements were conducted in the energy interval E_d = 1.9 to 3.0 MeV and for proton flight angles θ = 140 and 155°. The reactions studied were $^{28}Si(d,p_0)^{29}Si$ and $^{28}Si(d,p_1)^{29}Si^*$, and a beam of polarized deuterons was employed. The energy dependence of the vector analyzing power from deuteron elastic scattering by ^{28}Si at 2.0 to 3.0 MeV is shown for two angles. (4 figures) (KSW)

26129 EXCITATION OF ROTATIONAL BANDS IN ^{24}Mg BY 12-NUCLEON-TRANSFER. Klapdor, H. V.; Reiss, H. (Max Planck-Institut fuer Kernphysik, Heidelberg). J. Phys. (Paris), Colloq.; No. 5, 111(1972).

The rotational bands and nuclear structure of ^{24}Mg were studied using the $^{12}C(^{14}N,d)^{24}Mg$ reaction at 52 MeV. (FR)

26130 QUASIFREE (p,pα) REACTIONS AT 156 MeV ON SOME INTERMEDIATE AND HEAVY NUCLEI. Bachelier, D.; Bernas, M.; Bilaniuk, O. M.; Boyard, J. L.; Jourdain, J. C.; Radvanyi, P. (Paris Univ., Orsay, France). J. Phys. (Paris), Colloq.; No. 5, 121(1972). (In French).

The A-dependence of α-cluster parentage in nuclei was investigated from a (p,pα) experiment with ^{6}Li, ^{24}Mg, ^{28}Si, ^{40}Ca, ^{140}Ce and ^{232}Th targets. (FR)

26131 EFFECT OF THE POTENTIAL PARAMETERS ON THE SPECTROSCOPIC FACTORS OF THE $^{24}Mg(d,p)^{25}Mg$ REACTION. Scheib, U.; Hofmann, A.; Philipp, G.; Vogler, F. (Univ., Erlangen, Ger.). Nucl. Phys.; A203: No. 1, 177-192(1973).

The reaction $^{24}Mg(d,p)^{25}Mg$ was measured at a bombarding energy of 10 MeV to study the dependence of the spectroscopic factors on the potential parameters. It was found that definite small variations of the potential parameters can change the spectroscopic factors by a factor of 2. The asymptotic spectroscopic factors are found to be almost independent of these parameters. (9 figures, 3 tables) (auth)

26132 $^{22}Ne(d,n)^{23}Na$ REACTION. Childs, W. A.; Ritter, R. C.; Murphy, B. D.; Strang, R. M. (Univ. of Virginia, Charlottesville). Nucl. Phys., A; A203: No. 1, 133-144(1973).

Absolute differential cross sections were determined for 32 states from the $^{22}Ne(d,n)^{23}Na$ reaction by the neutron time-of-flight method. A gaseous ^{22}Ne target was bombarded with 5.5-MeV deuterons, and angular distributions were taken from 0° to 160°. In addition, yield curves were taken at a fixed angle of 10° in 0.5-MeV steps from 2.5 to 5.5 MeV. The analysis of both types of data used computer programs for DWBA and compound-nucleus calculations. With two exceptions and three additions the l_p values determined in the present experiment agree with those of a recent (τ,d) experiment on the same target nucleus. The two previous (τ,d) experiments show considerable differences in proton transfer strengths to various states. The present experiment agrees well with the one which showed generally lower strengths for individual states, and, hence, with an assumption of greater spreading of the single-particle strength. The implications of those results on the Nilsson-model scheme for ^{23}Na are discussed. (6 figures, 3 tables) (auth)

26133 $^{36}Ar(\alpha,\gamma_0)^{40}Ca$ REACTION AT EXCITATION ENERGIES IN THE REGION OF THE GIANT DIPOLE RESONANCE. Watson, R. B.; Branford, D.; Black, J. L.; Caelli, W. J. (Australian National Univ., Canberra). Nucl. Phys.; A203: No. 1, 209-220(1973).

The differential cross section for the $^{36}Ar(\alpha,\gamma_0)^{40}Ca$ reaction was measured at 90° to the beam direction in 125-keV, 50-keV, and 50-keV intervals over the bombarding energy ranges 6 to 17 MeV, 6.54 to 8.81 MeV, and 11.67 to 13.65 MeV, respectively. Gamma-ray angular distributions were measured at eighteen bombarding energies. The results indicate that the reaction proceeds through isolated 1^- levels and, to a lesser extent, 2^+ levels. Excitation energies and partial decay widths for the 1^- levels are presented. From a comparison of the $^{36}Ar(\alpha,\gamma_0)^{40}Ca$, $^{39}K(p,\gamma_0)^{40}Ca$, and $^{40}Ca(\gamma,n_0)^{39}Ca$ excitation functions, it is shown that the α-capture reaction most probably leads to exciting the predominantly T = 1 giant dipole resonance states through a T = 0 isospin impurity. The result presented here, that the α-reduced widths decrease by a factor of 40 over the excitation energy region considered, is discussed with regard to variations in the degree of isospin mixing with energy and a shell-model calculation. (7 figures, 3 tables) (auth)

26134 IS THERE A SELECTIVITY IN THE $(^{16}O,^{12}C)$ REACTIONS ON THE Ar ISOTOPES. Braun-Munzinger, P.; Gelbke, C. K.; Grama, N.; Homeyer, H.; Ridinger, E.; Stock, R. (Max-Planck-Institut fuer Kernphysik, Heidelberg). J. Phys. (Paris), Colloq.; No. 5, 74(1972).

Low-lying 0^+ states in ^{40}Ca, ^{42}Ca, and ^{44}Ca are selectively excited using the $(^{16}O,^{12}C)$ reaction on ^{36}Ar, ^{38}Ar, and ^{40}Ar at 44 MeV. The dependence of the zero-range DWBA cross section on Q-value for the $^{36}Ar(^{16}O,^{12}C)$ reaction is shown. (FR)

26135 REACTIONS $^{19}F(\gamma,x\gamma')$ AND $^{31}P(\gamma,x\gamma')$. Thomas, B. J.; Buchnea, A.; Irish, J. D.; McNeill, K. G. (Univ. of Toronto). Can. J. Phys.; 50: No. 24, 3085-3089(15 Dec 1972).

The spectra of deexcitation gamma rays following photodisintegration of ^{19}F and ^{31}P were measured to study further the reaction channels involved in photodisintegration of nonclosed-shell nuclei. Besides (γ,n) and (γ,p) decays to excited states of the residual nuclei, strong (γ,α) channels from ^{19}F to the first excited state of ^{15}N and from ^{31}P to the first two excited states of ^{27}Al were observed. (auth)

26136 STUDY OF THERMAL NEUTRON CAPTURE IN CHLORINE. Ishaq, A. F. M.; Kennett, T. J. (McMaster Univ., Hamilton, Ont.). Can. J. Phys.; 50: No. 24, 3090-3099(15 Dec 1972).

The gamma-ray spectrum after thermal neutron capture was studied using a Ge(Li) pair spectrometer. Out of 140 transitions observed above 1.95 MeV, 3 were tentatively assigned to ^{38}Cl and the rest, to ^{36}Cl. An improved decay scheme is proposed for ^{36}Cl which involves 43 levels. The Q value for the $^{35}Cl(n,\gamma)^{36}Cl$ reaction is estimated to be 8579.1 ± 0.5 keV and the multiplicity of the reaction found to be 2.5. A tentative estimate of the Q value for the $^{37}Cl(n,\gamma)^{38}Cl$ reaction yielded a result of 6107.4 ± 0.8 keV. The mean reduced widths for primary dipole transitions were calculated and compared with theoretical estimates. (auth)

26137 GAMMA-RAY LINEAR POLARIZATION MEASUREMENTS IN ^{33}S. Butler, P. A.; Carr, P. E.; Gadeken, L. L.; James, A. N.; Nolan, P. J.; Sharpey-Schafer, J. F.; Viggars, D. A. (Univ. of Liverpool). J. Phys., A (London); 6: No. 2, L15-L18(Feb 1973).

The reaction $^{30}Si(\alpha,n)^{33}S$ was used to populate levels in ^{33}S at α-particle energies of 7.7 MeV and 9.8 MeV. Gamma rays in ^{33}S were detected in a Ge(Li)–NaI(Tl) escape-suppressed spectrometer and a three-Ge(Li) Compton polarimeter. The analysis of angular distributions and experimental linear polarizations of γ rays gave spin and parity assignments of $\frac{5}{2}^+$, $\frac{3}{2}^+$, $\frac{7}{2}^+$ and $11\frac{1}{2}^-$ for the levels at 2868, 4050, 4096 and 4868 keV, respectively. (auth)

26138 NUCLEAR STUDIES RELATING TO BETA DECAY AND WEAK INTERACTIONS. Ryder, J. S. Oxford; Oxford Univ. (1972). 116p.

Thesis.

The determination is reported of the ft values of the superallowed pure Fermi decays of ^{14}O, ^{34}Cl and ^{38m}K. The Conserved Vector Current theory predicts that all the ft values for decays of this type should be equal. This prediction has been found to be approximately satisfied, the small scatter found among the experimental ft values being regarded as the result of charge-dependent mixing effects. The lowest experimental ft value, that of ^{26m}Al decay, corresponds to the smallest value of the charge-dependent correction, which has been calculated to be no larger than a few tenths percent. On the basis of the ^{26m}Al ft value, calculations of the vector coupling constant and of the Cabibbo angle have been made. A remeasurement of the ft values of other decays of low Z has been undertaken to allow a more accurate comparison with the ^{26m}Al ft value. The half-lives of the superallowed decays of ^{14}O and ^{34}Cl have been measured as 71.068 ± 0.030 s and 1.5253 ± 0.0021 s, respectively. The threshold energy of the $^{34}S(p,n)^{34}Cl$ reaction has been measured as 6458 ± 2.0 keV; and that of the $^{31}P(\alpha,n)^{34}Cl$ reaction, as 6371 ±

4.2 keV. The Q value of the reaction $^{31}P(\alpha,p)^{34}S$ has been measured as 629.9 ± 2.9 keV. The Q value of the reaction $^{34}S(p,n)^{34}Cl$ has been calculated from the (α,n) and (α,p) reaction results as −6272.7 ± 2.6 keV; this is in good agreement with the value inferred from the (p,n) reaction threshold as −6271.5 ± 2.0 keV. The weighted mean of these values was used to calculate the β^+ end point energy of the decay $^{34}Cl(\beta^+)^{34}S$. This, in turn, was used to calculate the integrated Fermi function. The ft value of ^{14}O has been calculated from the measured half-life, and from the results of an earlier Q value measurement, to be 3111 ± 11 s. That of ^{34}Cl has been obtained from the experimental value for the half-life and from the results of the Q value measurements to be 3091 ± 7 s. The new ft values of ^{14}O and ^{34}Cl are compared with the accepted value for ^{26m}Al decay. A preliminary result is also presented for the ft value of the superallowed decay of ^{38m}K. This is inferred from the decay half-life of ^{38m}K, the $^{35}Cl(\alpha,n)^{38m}K$ reaction threshold, and the $^{35}Cl(\alpha,p)^{38}Ar$ reaction Q value. (auth)

Nuclear Properties and Reactions, 39 ≤ A ≤ 58

Refer also to abstracts 24708, 25679, 26070, 26089, 26091, 26102–26104, 26126, 26130, 26133, 26134, 26189, 26194, 26199, 26202, 26220, 26222, 26223, 26278, 26280, 26320, 26369, 26375, and 26421.

26139 (ANL-7971) PHYSICS DIVISION ANNUAL REVIEW, 1 APRIL 1971–31 MARCH 1972. (Argonne National Lab., Ill.). 1972. Contract W-31-109-eng-38. 235p. Dep. NTIS.

BERYLLIUM-9—deuteron reactions (d,n) at 8.3 and 16.0 MeV, energy spectra from, (E)

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—oxygen-16 elastic scattering at 25 to 45 MeV, optical-model analysis of angular distribution and excitation function for, (E)

CALCIUM-41—energy levels from potassium-41 (He-3,t) reactions, (E)

CALCIUM-48—oxygen-16 elastic scattering at 25 to 45 MeV, optical-model analysis of angular distribution and excitation function for, (E)

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TITANIUM-49—helium-3 reactions (He-3,d) at 22 MeV, DWBA analysis of differential cross sections for, (E)

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ZIRCONIUM-94—deuteron reactions (d,p) at 12 MeV, DWBA analysis of differential cross sections and spectrum from, (E)

26140 (CONF-720404-(Vol.1), pp 128-143) DETERMINATION OF THE K-SHELL FLUORESCENCE YIELD OF Mn AFTER ELECTRON CAPTURE DECAY OF ^{55}Fe. Dobrilovic, Lj.; Bek-Uzarov, Dj.; Simovic, M.; Burael, K.; Milojevic, A. (Boris Kidric Inst., Belgrade). Jan 1973.

From International conference on inner shell ionization phenomena and future applications; Atlanta, Georgia, USA (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

The K-shell fluorescence yield, ω_K, of Mn, following electron capture decay of ^{55}Fe has been determined by independent measurements of the total K x rays and K Auger emission rate using a 4π proportional counter. The self-absorption has been minimized to an unobservable value by developing a method for mononuclear source preparation of ^{55}Fe. The value of ω_K obtained is 0.322 ± 0.005. (auth)

26141 (CONF-720404-(Vol.1), pp 144-157) DETERMINATION OF THE K-SHELL FLUORESCENCE YIELD OF ^{54}Cr USING THE COINCIDENCE AND ABSOLUTE COUNTING METHODS FOR K X-RAY PHOTONS. Konstantinov, A. A.; Sazonova, T. E.; Konstantinov, A. (Mendeleev Inst. of Metrology, Leningrad). Jan 1973.

From International conference on inner shell ionization phenomena and future applications; Atlanta, Georgia, USA (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

The value 0.267 ± 0.004 was found for the fluorescence yield of chromium following the electron capture decay of manganese-54. (JFP)

26142 (CONF-720404-(Vol.1), pp 164-174) K FLUORESCENCE YIELD OF THE ELEMENTS $20 < Z < 30$. Mukerji, A.; Chin, L. (City Univ. of New York, NY). Jan 1973.

From International conference on inner shell ionization phenomena and future applications; Atlanta, Georgia, USA (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

The ratio of the rates of production of K x rays per nuclear disintegration during the decay of ^{54}Mn and ^{65}Zn ($P_K\omega_K$) has been determined by measuring under identical geometrical conditions the coincidences between the K x rays following orbital electron captures and the gamma transitions from the excited states of the nuclei ^{54}Cr (850 keV) and ^{65}Cu (1114 keV). The probability of the K electron capture (P_K) in ^{54}Mn and ^{65}Zn has been computed theoretically. Adopting a weighted mean value of ω_K(Cu) from our published data and other recent precisely determined values, the K fluorescence yield of Cr has been obtained. The K fluorescence yield of iron has been obtained by measuring the rate of production of K x rays per nuclear disintegration in ^{57}Co by comparing the coincidence rates between the cascades K x ray 122 keV gamma and the 122-14.4 keV gamma transitions. The probability of K electron capture was computed theoretically. The measured values are given. (auth)

26143 (CONF-720404-(Vol.1), pp 278-284) K X-RAY GAMMA RAY DIRECTIONAL CORRELATION FOLLOWING ELECTRON CAPTURE. Ramaswamy, M. K. (Fordham Univ., Bronx, NY). Jan 1973.

From International conference on inner shell ionization phenomena and future applications; Atlanta, Georgia, USA (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

The question whether there is a directional correlation between the K x-ray following K-electron capture and the succeeding nuclear gamma-ray is of both theoretical and experimental interest. The theory of Dolginov denies the existence of any correlation. The earlier work of Perepelkin on ^{54}Mn gave indications of a correlation contrary to Dolginov's prediction. Since then this question has been pursued by various investigators on various nuclei and the general conclusion seems to be in accord with Dolginov's ideas. This paper reviews these results and briefly deals with the question of L x-ray gamma-ray directional correlations. (auth)

26144 (CONF-720404-(Vol. 3), pp 1895-1905) CHEMICAL EFFECTS ON INTERNAL CONVERSION. Emery, G. T. (Indiana Univ., Bloomington). Jan 1973.

From International Conference on inner shell ionization phenomena and future applications; Atlanta, Georgia, USA (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

Available data concerning chemical effects on internal conversion rates is reviewed, with special attention to multipolarity-dependent orbital selectivity, the relation between conversion rates and inner-atom electron densities, bond ionicities, and monopole shielding. The value of combining results from different kinds of experiments is noted. (auth)

26145 (CONF-720404-(Vol. 3), pp 1988-2003) ORBITAL ELECTRON CAPTURE RATIOS IN THE DECAY OF ^{55}Fe. Pengra, J. G.; Genz, H.; Renier, J. P.; Fink, R. W. (Georgia Inst. of Tech., Atlanta). Jan 1973.

From International conference on inner shell ionization phenomena and future applications; Atlanta, Georgia, USA (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

The M/L and L/K orbital electron capture ratios in the decay of ^{55}Fe have been determined by introducing the radioactive compound ferrocene-^{55}Fe into a multiwire, wall-less anticoincidence proportional counter as part of the counting gas mixture. The results are $P_M/P_L = 0.156 \pm 0.003$ and $P_L/P_K = 0.117 \pm 0.001$ at Z = 26. These values are compared with various theoretical predictions and, together with previous experimental results on M/L capture ratios at low Z, demonstrate that of all the combinations of theoretical approaches, the Watson–Freeman wave functions with the exchange corrections of Vatai is the only one which gives good agreement with experiment at low Z. All other theoretical combinations lie considerably higher than experiment in the region below Z = 36. (auth)

26146 (COO-1051-51) SIMPLE EXCITATIONS OF DOUBLY CLOSED SHELL NUCLEI. Trilling, R. (Michigan State Univ., East Lansing). 1972. 269p. Dep. NTIS $15.50.

Thesis.

The problem of describing low-lying excitations in doubly closed-shell nuclei by simple one-particle–one-hole excitations has long been of theoretical interest. Without including either core correlation or core polarization contributions in the matrix elements the agreement between experiment and theory of previous calculations has been marginal. The previous calculations have failed to produce enough separation between the T = 0, 1 states of N = Z nuclei and, therefore, have produced too much isospin mixing in these light nuclei. Another failure of the previous calculations was that the binding energy of the states (T = 0, 1) was too small. The error in the binding of the T = 0 states (N = Z nuclei) was much greater than the error in the binding of the T = 1 states. The present calculation replaces the monopole term of the multipole expansion of the interaction by a one-parameter isospin-dependent spherical potential. The parameter is evaluated from the symmetry energy between ^{48}Ca and ^{49}Sc. The reason for the replacement is to take into account the difference between the single-particle energies of the A ± 1 mass nuclei used in the calculation and those of the A mass system in which the excited particle moves. Two different interactions, the Kallio–Kolltveit and the Sussex, were used in two different approximations, the TDA and the RPA. The results obtained with the two different interactions are quite similar; and, aside from the lowest 3^- state, the results obtained from the TDA and the RPA were almost identical. By using the monopole shift the results for ^{16}O are greatly improved. The T = 0, 1 separation energies increase, along with their binding energies, to where they are in close agreement with experiment. The isospin mixing of the new vectors is such that most of the calculated B(E1)'s are now in good agreement with experiment. The transition data for ^{40}Ca include only the 3^-, 5^- T = 0 levels. The monopole shift does not affect these transitions, but gives a net improvement of the position of the levels arising from the three lowest multiplets. The resultant placement of the levels is also in good agreement with the deformed-basis calculation of ^{40}Ca by Gerace and Greene. The giant dipole state is, however, about 1 MeV too low when the shift is used. In ^{48}Ca and ^{88}Sr only the $T_<$ states were calculated. The monopole shift leads to a definite improvement in the level positions of both nuclei for both the negative-parity and the positive-parity states. In all nuclei the RPA overbinds the lowest 3^- state; a reduction of the interaction strength to 65%, in order to simulate screening, for all the nuclei leads to a fair agreement between experiment and theory. It should be noted that the calculations for ^{88}Sr predict a strong low-lying 5^- state, which up to now has not been seen. (8 figures, 19 tables) (auth)

26147 (EURFNR-1064) TOTAL CROSS-SECTION OF ^{54}Fe IN THE keV ENERGY REGION. Beer, H.; Spencer, R. R.; Froehner, F. H.; Cho, M. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Angewandte Kernphysik). Dec 1972. 14p. (KFK-1516; EANDC(E)-145-AL). Dep. NTIS.

Work performed under United States — Euratom Fast Reactor Exchange Program.

The total neutron cross section of ^{54}Fe was measured with the time-of-flight method at the 3-MeV Karlsruhe Van de Graaff Accelerator in the energy region from 6 keV to 300 keV. The data points were analyzed with an R-Matrix multilevel formula; and the resonance parameters of the detected resonances, determined. (3 figures, 1 table) (auth)

26148 (EURFNR-1065) TOTAL NEUTRON CROSS SECTIONS OF ^{50}Cr, ^{52}Cr, ^{62}Ni, AND ^{64}Ni IN THE ENERGY REGION 10 TO 300 keV. Spencer, R. R.; Beer, H.; Froehner, F. H. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Angewandte Kernphysik). Nov 1972. 24p. (KFK-1517; EANDC(E)-146-AL). Dep. NTIS (U. S. Sales Only) $3.25.

Work performed under United States — Euratom Fast Reactor Exchange Program.

Neutron total cross sections of ^{50}Cr, ^{52}Cr, ^{62}Ni and ^{64}Ni were determined in the energy region from 10 to 300 keV by means of transmission measurements on enriched samples. R-matrix fits to the transmission data were carried out, and the parameters thus determined are presented. (8 figures, 6 tables) (auth)

26149 (FRNC-TH-235) SPECTROSCOPIC STUDY OF ^{41}Sc USING PROTON RESONANCE SCATTERING. Establishment of an Intermediate Structure and Interpretation of the Levels with Deformed Configurations. Mittig, W. (Paris Univ., Orsay (France)). 1971. 139p. (In French). INIS.

Thesis.

The resonance reaction ^{40}Ca (p,p') was studied between 5 and 8.2 MeV. The concept of quasi-direct reactions enabled the structural relations between ^{41}Sc and ^{40}Ca to be deduced from the experimental values of the partial widths. The important resonances observed on the excitation function for the 3-state (3.74 MeV) could be reduced to a simple state originating an intermediate structure. This state was demonstrated to be a weak-coupling state of a ^{40}Ca core in the 3- state with a $2p_{\frac{1}{2}}$ particle. The experimental results were compared with those obtained with a mixing of deformed and spherical configurations in the Gerace and Green model. A very simple description of the positive states of ^{40}Ca was used; the introduction of only one supplementary parameter enabled 60 negative states of ^{41}Sc with spin varying from ½ to 7/2 to be obtained. The calculated and experimental results are in good agreement up to 5 MeV. Above 5.6 MeV the density of the levels observed for ^{40}Ca becomes higher than that of the calculated levels. However, the calculation gives the exact values of the spectroscopic factors for the elastic and inelastic channels. (INIS)

26150 (FRNC-TH-297) EXPERIMENTAL STUDY OF THE PRODUCTION OF LIGHT FRAGMENTS AND NEUTRON DEFICIENT ISOTOPES IN THE GeV REGION. Legarde, M. (Bordeaux Univ. (France)). 1972. 183p. (In French). Dep. NTIS (U. S. Sales Only).

Thesis.

The mechanisms by which ^{32}P and ^{35}S isotopes are produced in targets (lying between Sc and U) by protons having energies of 0.6, 3, 10.5, and 21 GeV were studied. The production of ^{83}Rb, ^{84}Rb, and ^{86}Rb isotopes in targets (lying between Y and U) by protons having energies of 0.8, 10.5, and 21 GeV was also studied. The thick target recoil technique was used with thick collectors. The F/B ratio (F = activity measured in front of the

target, B = activity measured behind the target), the paths, the kinetic energies of the isotopes studied, and the excitation energies of the residual nuclei of the cascade were determined. Rb isotopes were selected for studies of the changes occurring in neutron deficient and neutron rich nuclei as a function of the element irradiated and the incident energy. Targets adjacent to the products studied enabled a spallation test to be set up in view of examining neutron-deficient nuclei. The mean values obtained by Monte Carlo calculations for the two-step model (fission and evaporation) allowed the effect of fissioning nuclei and mass division along the fragment paths to be evaluated. The observed results were compared with known fission and spallation reactions; the domain of fragmentation being deduced. (France)

26151 (ISS-72/9) PROTON ANGULAR DISTRIBUTIONS IN CALCIUM THROUGH (e,e'p) REACTIONS. Campos Venuti, G.; Capitani, G. P.; Cortellessa, G.; De Sanctis, E.; Farchi, G.; Frullani, S.; Giordano, R.; Salvadori, P.; Tokamatsu, K. (Istituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica). 15 May 1972. 48p. (In Italian). Dep. NTIS (U.S. Sales Only) $4.50.

The formalism adopted for discussion in quasi-elastic scattering measurements is recalled. The experimental apparatus used in the (e,e'p) reaction is described, and proton angular distributions measured at separation energies of 39 and 81 MeV in calcium are presented. Finally, results of (p,2p) and (e,e'p) on calcium are compared, and the need for further experiments is stressed. (auth) (10 figures, 4 tables)

26152 (KFK-1516) TOTAL NEUTRON CROSS SECTION OF ^{54}Fe IN THE KEV ENERGY REGION. Beer, H.; Spencer, R. R.; Froehner, F. H.; Cho, M. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Angewandte Kernphysik). Dec 1972. 16p. (In German). (EANDC(E)-145-AL). Dep. NTIS (U.S. Sales Only) $3.00.

The total neutron cross section of ^{54}Fe was measured with the time-of-flight method at the 3-MeV Karlsruhe Van de Graaff Accelerator in the energy region from 6 keV to 300 keV. The data points were analyzed with an R-Matrix multilevel formula; and the resonance parameters of the detected resonances, determined. (auth) (3 figures, 2 tables) (auth)

26153 (NRCN-260) STUDY OF LEVEL STRUCTURE OF THE TITANIUM ISOTOPES USING THE (n,γ) REACTION. Tenenbaum, J. (Israel Atomic Energy Commission, Beersheba. Nuclear Research Center-Negev; Hebrew Univ., Jerusalem (Israel)). Aug 1971. 114p. (In Hebrew). INIS.

Thesis.

The stable titanium isotopes were studied using the (n,γ) reaction to obtain exact spectroscopic information on the nuclear levels and their properties; and information on the reaction mechanism and whether there is a direct capture contribution to the cross section in accordance with the theory of Lane and Lynn were also investigated. To identify the source of gamma lines, enriched TiO_2 targets were used. Because of the high cross section of ^{48}Ti and its relative high abundance in the targets, it was necessary in certain energy regions to carry out comparison measurements with a natural TiO_2 target to identify the source of some of the gamma lines. The direct spectrum of the gamma lines from the (n,γ) reaction was measured with a Ge(Li) detector. The gamma energies and the relative intensities of the transitions were measured. The energy determination of the different transitions coupled with coincidence measurements with the strong transitions of the various targets permitted construction of the decay schemes of the five isotopes ^{47}Ti, ^{48}Ti, ^{49}Ti, ^{50}Ti, ^{51}Ti. From the decay schemes the neutron binding energies were evaluated. From measurement of the angular distributions of the cascades the spins of the different levels were evaluated. Results were in agreement with previous measurements. For the 2.556-MeV level in ^{47}Ti the present results show a spin of $^3/_2$, in disagreement with the value of $^1/_2$ assigned by Lee and Schiffer. This confirms that the empirical J-dependence rule may not be reliable for levels having small values of the spectroscopic factor. For many levels a unique value of the spin could not be deduced, but the number of possible spin assignments was reduced. From the angular distribution results it could be concluded that the transitions between low-lying states are mixed, and the possible mixing parameters were evaluated. It was shown that the two possible spins of the ^{48}Ti capture state, 3^- and 2^-, contribute to the population of lower-lying states, while in the case of ^{50}Ti there are indications that only the 3^- capture-state spin contributes. Comparison of the reduced widths of the (n,γ) and (d,p) reactions for the different Ti isotopes gave information on the (n,γ) reaction mechanism. It was concluded that, for the ^{46}Ti target, the results are consistent with the assumption that the predominant contribution to the cross section comes from the direct reaction. For the targets ^{47}Ti, ^{48}Ti, ^{49}Ti it appears that the predominant contribution to the cross section can not be either the direct capture mechanism or the internal resonance capture mechanism; therefore, one has to attribute the main contribution to the cross section to channel resonance capture. These results are of interest since the Ti isotopes lie in a mass region where nuclei should have a strong contribution from the direct capture reaction mechanism according to the predictions of Bockelman. (INIS)

26154 (OULNS-72-1) ANNUAL REPORT OF LABORATORY OF NUCLEAR STUDIES, OSAKA UNIVERSITY, 1971. (Osaka Univ. (Japan). Lab. of Nuclear Studies). 1971. 71p. NTIS (U. S. Sales Only).

Research and technical development conducted in Laboratory of Nuclear Studies, Osaka University, during 1971 are reviewed. The research was carried out by the faculty members and graduate students of Departments of Physics, Chemistry and Biology and by the staffs of the Laboratory. Most works are continuation or extension of those reported previously. In Cyclotron Division, a 110-cm cyclotron has been operated satisfactorily for nuclear physics experiments and radioisotope production. Measurement of proton asymmetry, study on (α,d) and (α,t) reactions, and other studies were carried out. In High Voltage Accelerator Division, nuclear magnetic resonance was used for the determination of nuclear magnetic moment of β-radioactive nuclei. Measurement of polarization and magnetic substate population and measurement of β-decay lifetime were carried out. In Mass Spectroscopy Division, research on precise atomic mass measurement, isotopic abundance anomaly and atomic collision problem was continued. In Radioisotope Division, measurement of annihilation γ-ray, search of target-ion source system, improvement of low energy electron spectrometer, and study on the radiation effect of DNA and RNA were carried out. In Theoretical Physics Division, studies on nuclear structure and reaction and problems of elementary particle physics were continued. Two colloquia were held in February and September 1971, on the photoproduction of charged pions and tandem accelerator experiment respectively. Thirty-seven papers were published in periodicals and others. (JA)

26155 LEVELS OF ^{48}V APPEARING IN THE REACTION ^{47}Ti(p,γ)^{48}V. Basina, A. S.; Kraft, O. E.; Naumov, Yu. V.; Kucherov, A. S.; Lebedev, P. P. Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 10, 2105-2110(Oct 1972). (In Russian).

The spectrum of γ rays from the reaction ^{47}Ti(p,γ)^{48}V was studied with a Ge(Li) detector up to 4.2 MeV in energy. A beam of 1.6-MeV protons was incident on a TiO_2 target, the thickness of which corresponded to a proton energy loss of 100 keV. The energy-level diagram was constructed for ^{48}V. (2 figures, 1 table) (KSW)

26156 SYSTEMATIC INVESTIGATION OF (n,t) REACTIONS AT 14 TO 15 MeV ON MEDIUM AND HEAVY MASS NUCLEI. Qaim, S. M.; Stoecklin, G. L. (Kernforschungsanlage, Juelich, Ger.). J. Inorg. Nucl. Chem.; 35: No. 1, 19-30(Jan 1973).

(n,t) reaction cross-sections have been measured at E_n = 14.6 ± 0.4 MeV for ^{32}S, ^{40}Ca, ^{50}Cr, ^{54}Fe, ^{64}Zn, ^{70}Ge, ^{89}Y, ^{92}Mo, ^{139}La and ^{197}Au by the activation technique in combination with specific radiochemical methods. The measured cross-sections lie in the microbarn region. Possible mechanisms of the (n,t) reaction are discussed. A study of the systematics of this reaction has been carried out, and some of the observed trends in reaction cross-sections are described. Similarly to the (n,p) and (n,α) reactions, the (n,t) reaction cross-sections for elements with Z between 24 and 92 decrease with increasing asymmetry parameter (N − Z)/A of the target nucleus. (auth)

26157 STUDY OF THE (d,^{6}Li) REACTIONS WITH ^{40}Ca, ^{42}Ca, ^{56}Fe, ^{58}Ni NUCLEI AT 28 MeV. Viano, J. B.; Loiseaux, J. M.; Le Chalony, Y.; Martin, P. (Univ., Grenoble, France). J. Phys. (Paris), Colloq.; No. 5, 73(1972). (In French).

The ^{6}Li nucleus is described using the α-cluster model; (d,^{6}Li) reactions are used to investigate four-nucleon correlations in nuclei. (FR)

26158 DOUBLE NUCLEON STRIPPING REACTIONS ON ^{54}Fe AND ^{58}Ni USING AN 80-MeV ^{16}O BEAM. Pougheon, P.; Roussel, P.; Colombani, P.; Doubre, H.; Roynette, J. C. (Paris Univ., Orsay, France). J. Phys. (Paris), Colloq.; No. 5, 83(1972). (In French).

The double-nucleon-stripping reactions (^{16}O, ^{14}N) and (^{16}O, ^{14}C) on ^{54}Fe and ^{58}Ni targets were studied using an 80-MeV ^{16}O beam. The levels observed in ^{58}Ni(^{16}O, ^{14}N)^{60}Cu and ^{58}Ni(^{16}O, ^{14}C)^{60}Zn are compared. (FR)

26159 LIMITS TO THE FORMATION OF COMPOUND NUCLEI IN HEAVY ION INDUCED REACTIONS. Natowitz, J. B.; Chulick,

E. P. (Texas A and M Univ., College Station). J. Phys. (Paris), Colloq.; No. 5, 52(1972).

The recoil product nuclei from the reactions of 45- to 180-MeV ^{12}C with ^{27}Al, Cr, ^{48}Ti, Ni and Cu targets were observed. Values of the limiting angular momentum are derived under the assumption that noncompound processes occur preferentially at the highest impact parameters. (FR)

26160 STUDY OF NEUTRON TRANSFER ACROSS THE COULOMB BARRIER. Buttle, P. J. A.; Durell, J. L.; Goldfarb, L. B. J.; Lilley, J. S.; Phillips, W. R. (Univ. of Manchester, Eng.). J. Phys. (Paris), Colloq.; No. 5, 54(1972).

The reaction studied is the ground-state process $^{48}Ca(^{17}O, ^{16}O)^{49}Ca$. Both ^{17}O elastic scattering and differential cross sections for the transfer process were observed with beam energies of 27, 28, 29 and 30 MeV. (FR)

26161 STUDY OF THE (^{7}Li,t) REACTION ON ^{40}Ca AND ^{54}Fe TARGETS AT LOW INCIDENT ENERGY. Cunsolo, A. (CEN de Saclay, Gif-sur-Yvette, France); Lemaire, M. C.; Mermaz, M. O.; Quebert, J. L.; Sztark, H. J. Phys. (Paris), Colloq.; No. 5, 66(1972).

The $^{40}Ca(^7Li,t)^{44}Ti$ and $^{54}Fe(^7Li,t)^{58}Ni$ α-transfer reactions were studied at an incident energy of 16 MeV. Angular distributions were measured for levels up to excitation energies of 9 MeV. (FR)

26162 DECAY OF ^{44}Sc. Simpson, J. J. (Univ. of Guelph, Ont.). Nucl. Phys.; A203: No. 1, 221-224(1973).

The 3.9-h decay of the ^{44}Sc ground state was investigated with a ^{44}Ti source. In a singles experiment with a Ge(Li) detector and a $\gamma-\gamma$ coincidence experiment with a NaI(Tl)–Ge(Li) detector arrangement, a $(0.010 \pm 0.002)\%$ EC branch to the 3.30-MeV level of ^{44}Ca was found. The γ-decay branching ratio of the 3.30-MeV level was determined. (2 figures, 1 table) (auth)

26163 LEVELS IN ^{44}Ca EXCITED BY THE β-DECAY OF ^{44}K. Ing, H. (Atomic Energy of Canada Ltd., Chalk River, Ont.); King, J. D.; Schulte, R. L.; Taylor, H. W. Nucl. Phys.; A203: No. 1, 164-176(1973).

The β decay of 22-min ^{44}K was reinvestigated with a Ge(Li) spectrometer of improved resolution and efficiency. A total of 58 γ rays was assigned to the decay of ^{44}K. Of these, 53 were incorporated into a revised decay scheme containing 20 excited states. The ^{44}K half-life was determined to be 22.15 ± 0.20 min. (3 figures, 2 tables) (auth)

26164 ELASTIC AND INELASTIC SCATTERING OF ^{16}O AND ^{12}C FROM A = 40 to 96 NUCLEI. Becchetti, F. D. (Univ. of California, Berkeley); Christensen, P. R.; Manko, V. I.; Nickles, R. J. Nucl. Phys.; A203: No. 1, 1-16(1973).

Angular distributions for the elastic scattering of ^{16}O by $^{40,48}Ca$, ^{50}Ti, ^{52}Cr, ^{54}Fe, $^{58,60,62,64}Ni$, $^{86,88}Sr$, $^{92,96}Zr$, and ^{92}Mo at an incident energy of 60 MeV, ^{16}O by ^{96}Zr at 49 MeV, and ^{12}C by ^{96}Zr at 38 MeV were measured. Inelastic scattering of ^{16}O by ^{48}Ca, ^{54}Fe, ^{58}Ni, ^{88}Sr, ^{96}Zr (60 MeV) and ^{12}C by ^{96}Zr (38 MeV) populating low-lying collective states of the target was also measured. The elastic scattering angular distributions are characteristic of those for strongly absorbed particles. The inelastic data show structure, however, which is found to be due to the destructive interference between Coulomb and nuclear excitation. The data are analyzed using the optical model with collective form factors. Deformation parameters in good agreement with those obtained by other means can be extracted, provided corrections for the finite size of the projectile are made. (12 figures, 3 tables) (auth)

26165 ERROR SOURCES IN MEASUREMENTS OF SMALL CIRCULAR POLARIZATION OF γ-RAYS. Bock, P. (Univ., Karlsruhe, Ger.). pp 137-160 of Symposium on Nucleons and Weak Interactions. Eman, B. (ed.). Zagreb; Institute Rudjer Boskovic (1971).

From Symposium on nucleons and weak interactions; Zagreb, Yugoslavia (Jul 1971). See CONF-710737-.

Some aspects of the experimental method consisting of measuring the circular polarization of nuclear gamma rays emitted by unpolarized sources are discussed in detail. Results are found for titanium-46 using a scandium-46 source and tantalum-181. (JFP)

26166 USE OF RADIOACTIVITY IN EXCITATION CURVE MEASUREMENTS. Nelson, J. W.; Plendl, H. S. (Florida State Univ., Tallahassee). pp 565-572 of Radioactivity in Nuclear Spectroscopy. Vol. I. Hamilton, J. H. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From International Conference on Radioactivity in Nuclear Spectroscopy; Nashville, Tennessee, United States of America (USA) (11 Aug 1969). See CONF-690818-(Vol.1).

Radioactivity measurement for excitation curve determination was reported in 1950 by Snowden. This technique has been employed by researchers in a number of laboratories in a variety of different experiments. At Florida State University, equipment was developed to exploit this method for nuclear reactions which lead to radioactive products of half-life 1-millisecond or greater. Information is obtained on the levels of the compound system and also the residual nucleus in the case of neutron-emitting reactions. Advantages of this radioactivity method include ease of determination of the absolute value of the reaction cross section, reduction of background due to counting with beam off target, use of both energy and time discrimination in the counting system, and the use of thick backed targets in which isotopic enrichment is often not necessary. Typical results for (p,n) and (α,n) experiments are presented. (8 figures) (auth)

26167 (p,p′) INELASTIC SCATTERING. Koike, Y. (Nagaoka Technical Coll., Niigata, Japan). Nagaoka Kogyo Koto Senmon Gakko Kenkyu Kiyo; 7: No. 1, 29-37(Mar 1971). (In Japanese).

The inelastic scattering amplitude, when it is calculated by the theory of direct nuclear reaction, depends for one thing on the potential energy. Therefore, five different potentials are assumed, the scattering amplitude being calculated in each case. Then the results are checked to see how differently each of the five potentials can affect the amplitude figure. Finally the calculated amplitude figures are compared for consideration with the available experimental Ti(p,p′)Ti* data concerning inelastic scattering. (auth) (Japan)

26168 NEUTRON-INDUCED REACTIONS IN MEDIUM MASS NUCLEI. Pearlstein, S. (Brookhaven National Lab., Upton, NY). J. Nucl. Energy; 27: No. 2, 81-99(Feb 1973).

In the neutron energy range below 20 MeV about 20 neutron reactions are energetically possible. These reactions are analyzed using a statistical model. Since direct reaction effects can be important, the calculations are normalized to experiment so as to partly compensate for deficiencies in the model. The empirical model is similar to previous work used to describe (n,2n) reactions but is extended to include charged-particle emission. Relatively good agreement is obtained with measured excitation curves and 14 MeV cross-sections using a single set of fitting constants. The method of analysis has been incorporated into a computer code THRESH. For crude calculations the code requires only Z and A as input, but improved fits in individual cases can be attained through simple parameter variation. Cross-sections and fission spectrum averages are calculated for nuclides in the range Z = 21–41. (auth)

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Refer also to abstracts 24708, 24725, 25679, 26070, 26089, 26091, 26102, 26103, 26126, 26139, 26142, 26143, 26146, 26148, 26150, 26156, 26158, 26159, 26164, 26168, 26189, 26192, 26199, 26202, 26204, 26220, 26222, 26223, 26229, 26230, 26280, and 26369.

26169 (ANU-P-564) ANNUAL REPORT, 1972. (Australian National Univ., Canberra. Dept. of Nuclear Physics). Jan 1973. 46p. Dep. NTIS (U. S. Sales Only) $4.50.

Progress and testing of the injector cyclotron and 14UD tandem accelerator installation at ANU are described and the use of other research equipment is summarized. The research program is outlined for the following topics; reaction mechanism topics; isobaric analogue states; heavy-ion induced reactions; radiative proton capture studies with Ge(Li) detectors; radiative capture of complex particles using the 10 in. NaI(Tl) detector; general nuclear spectroscopy; and beam-foil spectroscopy. (AT)

26170 (CONF-720404-(Vol. 1), pp 197-205) PRECISION DETERMINATION OF THE K-SHELL FLUORESCENCE YIELD OF ARSENIC. Chew, W. M.; McGeorge, J. C.; Fink, R. W. (Georgia Inst. of Tech., Atlanta). Jan 1973.

From International conference on inner shell ionization phenomena and future applications; Atlanta, Georgia, USA (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

Recent determinations of K-shell fluorescence yields in the middle-Z region, obtained by gaseous proportional counting techniques, have cast doubt on some older results obtained through the use of solid radioactive sources. In the present work, the K-shell fluorescence yield of arsenic was obtained by the $P_K \omega_K \epsilon_K$

method, by using a solid ^{75}Se radioactive source. The value obtained is $\omega_K = 0.589 \pm 0.027$, where the two sigma statistical error has been added linearly to the systematic error. This result is in good agreement with a value of $\omega_K = 0.587$ at Z = 33 which was obtained by fluorescent excitation of gaseous AsH_3. (auth)

26171 γ-DECAY OF STATES OF ^{64}Cu AND ANGULAR DISTRIBUTION γ-RADIATION ORIGINATING IN THE REACTION $^{64}Ni(p,n)^{64}Cu$. Naumov, Yu. V.; Kraft, O. E.; Lebedev, P. P.; (and others) (Leningrad State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 10, 2097-2104(Oct 1972). (In Russian).

The γ de-excitation of levels up to 1,850 keV excited by the reaction $^{64}Ni(p,n\gamma)^{64}Cu$ was studied. Foils enriched in ^{64}Ni (90.3%) were subjected to 6-MeV protons from a cyclotron. Angular distributions of γ rays were measured for the establishment of the quantum characteristics of certain levels in ^{64}Cu for bombardment with 6-MeV protons with the release of neutrons of energies up to 3.5 MeV. (2 figures, 4 tables) (KSW)

26172 NEUTRINOLESS DOUBLE-BETA DECAY OF ^{76}Ge. Fiorini, E. (Univ., Milan); Pullia, A.; Bertolini, G.; Cappellani, F.; Restelli, G. Nuovo Cim.; 13A: No. 3, 747-763(1 Feb 1973).

An underground experiment where a Ge(Li) diode is used both as source and as detector of the lepton nonconserving neutrinoless $\beta\beta$ decay of ^{76}Ge is reported. A 68.5 cm^3 active volume Ge(Li) heavily shielded against local radioactivity has been operated for about 4400 h of effective running time in a laboratory situated in the Mont Blanc tunnel (4.200 m of water equivalent). No evidence for neutrinoless decay was found with an upper limit on the lifetime of $\tau_{0\nu} > 5 \cdot 10^{21}$ years at 68% confidence level. This result, together with those of other experiments on different nuclei, is discussed in connection with the present theories on lepton nonconservation, and a limit on the lepton nonconserving amplitude is obtained. (auth)

26173 ECONOMICAL PROGRAMS FOR COMPUTER ANALYSIS OF GAMMA RAY DATA. Rester, A. C.; Ramayya, A. V.; Hamilton, J. H. (Vanderbilt Univ., Nashville). pp 1307-1315 of Radioactivity in Nuclear Spectroscopy. Vol. II. Hamilton, J. H. (Ed.). New York; Gordon and Breach Publishers, Inc. (1972).

From International Conference on Radioactivity in Nuclear Spectroscopy; Nashville, Tennessee, United States of America (USA) (11 Aug 1969). See CONF-690818-(Vol. 2).

26174 NUCLEAR STRUCTURE STUDIES OF THE ODD-N GERMANIUM ISOTOPES WITH (d,p) REACTIONS. Kato, N. (Kyushu Univ., Fukuoka). Nucl. Phys.; A203: No. 1, 97-120(1973).

The (d,p) reactions on $^{72,74,76}Ge$ were investigated with 6.02-MeV deuterons from the Kyushu University electrostatic generator. Many new levels of the residual nuclei were found up to about 4 MeV excitation energy. It was found that the (d,p) transitions with appreciable population strength proceeded predominantly via the direct reaction process. From the DWBA analysis of the cross sections and the proton angular distributions, spectroscopic factors and l_n values were obtained from approximately 80 levels. A sum-role analysis was successfully applied to the results and the emptiness of low-lying shell-model states was extracted. (13 figures, 7 tables) (auth)

26175 STUDY OF NEUTRON DEFICIENT BROMINE ISOTOPES PRODUCED WITH HEAVY ION INDUCED REACTIONS. Bakhru, H.; Ladenbauer-Bellis, I. M. (Yale Univ., New Haven). pp 381-394 of Radioactivity in Nuclear Spectroscopy. Vol. I. Hamilton, J. H. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From International Conference on Radioactivity in Nuclear Spectroscopy; Nashville, Tennessee, United States of America (USA) (11 Aug 1969). See CONF-690818-(Vol.1).

$^{74,76}Br$ produced via heavy-ion reactions like Cu + ^{12}C and Cu + ^{14}N were studied. The half-lives and the decay characteristics of these isotopes were determined using high-resolution Ge(Li) detectors in singles and in coincidence mode. High-resolution Ge(Li) singles γ-ray studies revealed the presence of several previously unreported transitions and resolved close-lying γ rays. The spectral complexities required the use of 2 Ge(Li) detectors in coincidence studies in conjunction with a PDP-8/I computer. The new level schemes of various Se isotopes are compared and discussed. (8 figures, 3 tables) (auth)

26176 TRIPLE ANGULAR CORRELATIONS. Robinson, R. L. (Oak Ridge National Lab., TN). pp 549-556 of Radioactivity in Nuclear Spectroscopy. Vol. I. Hamilton, J. H. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From International Conference on Radioactivity in Nuclear Spectroscopy; Nashville, Tennessee, United States of America (USA) (11 Aug 1969). See CONF-690818-(Vol.1).

Triple angular correlations between three coincident gamma rays from the decay of radioactive nuclei have potentially the capabilities of providing information on spins and radiative admixtures. They could in some cases, for example, resolve ambiguities in spin assignments and radiative admixtures that take place in double angular correlation studies. Although no gamma–gamma–gamma angular correlations have been reported prior to this meeting, a very similar correlation has been used in Coulomb excitation studies at Oak Ridge. Here the correlation is between the beam affecting Coulomb excitation and two coincident gamma rays from the Coulomb excited state. Except for particle parameters this triple correlation is treated in exactly the same way as that between three coincident gamma rays. Application in these Coulomb excitation studies of a special case of the triple correlation in which one of the gamma rays is observed parallel to the beam has proven to be a valuable spectroscopic tool. As an example, the 561–276-keV gamma-ray cascade from the Coulomb excited state at 837 keV in ^{81}Br is discussed. The correlation equation for this special geometry as adapted to gamma–gamma–gamma correlations is presented. (3 figures) (auth)

26177 PHOTOACTIVATION AS A TOOL FOR NUCLEAR LEVEL STUDIES. Boivin, M.; Heno, Y.; Cauchois, Y. (Laboratoire de Chimie Physique, Paris). pp 557-563 of Radioactivity in Nuclear Spectroscopy. Vol. I. Hamilton, J. H. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From International Conference on Radioactivity in Nuclear Spectroscopy; Nashville, Tennessee, United States of America (USA) (11 Aug 1969). See CONF-690818-(Vol.1).

Since the first experiments revealing nuclear photoactivation (1939), the increase in intensity of radiation sources, the improvement in excitation conditions, and the higher sensitivity of selective detectors have led to the possible use of this method in the study of low-energy nuclear levels. However, it can be used only if the nuclei have a metastable state with a mean lifetime long enough for the activity to be measured after irradiation. For the experiments reported the photon source was the bremsstrahlung from an electron accelerator (with an energy up to less than 2 MeV); use was made of crystal scintillator detectors, NaI(Tl), and natural or isotopic enriched substances as samples. The isomer periods studied ranged from a few hours down to under 20 s. The results show that with this method one can obtain, not only the photoactivation cross sections, but also interesting data on the characteristics of the levels involved, namely, the energy, angular momentum, parity, partial widths, and mean lifetime. Photoactivation permits the study of transitions of very low intensity. A pneumatic system for sample transfer was constructed so that isomers with smaller periods could be studied; however, the limit is of the order of one second. Thus, relatively simple apparatus associated with a low-energy accelerator has made it possible to carry out nuclear analysis in a laboratory which, compared with institutes highly specialized in nuclear physics, has very limited means. (2 figures, 1 table) (auth)

26178 RELATIVE KRYPTON ISOTOPE YIELD FROM THE IRRADIATION OF TARGETS WITH 660-MeV PROTONS. Levskii, L. K.; Murin, A. N.; Yutlandov, I. A. (Leningrad State Univ.). Geokhimiya; No. 11, 1406-1408(Nov 1972). (In Russian).

Samples of RbCl and $SrCl_2$ were irradiated in a synchrocyclotron with 660 MeV protons for 30 hr, and the relative yields of $^{78,80,81,82,84,85,86}Kr$ were determined with a mass spectrometer. The krypton isotope analyses were compared with the krypton analyses from meteors, which indicated that the cosmogenic krypton contained an abnormally high content of ^{83}Kr. (KSW)

26179 SPIN DEPENDENCE OF NEUTRON STRENGTH FUNCTIONS OF NUCLEI. Pikel'ner, L. B. (Joint Inst. for Nuclear Research, Dubna, USSR). Probl. Fiz. Elem. Chastits At. Yadra; 2: No. 4, 917-924(1972). (In Russian).

The experimental determination of the neutron strength function $S = \overline{\Gamma}_n^0/D$ is based on 2 fundamental methods of neutron spectroscopy: study of isolated resonances and measurement of the mean cross section of the interaction of neutrons with nuclei. The measurements yielded more or less precise values of S for most stable isotopes, and helped to identify giant resonances relating the strength function to the mass number and explaining the relationships on the basis of the optical model. Following up the work carried out at Saclay, neutron resonance parameters were determined at Dubna in the mass number range from 69 to 87, including nuclei with an odd A (^{77}Se, ^{69}Ga, and ^{71}Ga), for which many levels were found by simultaneously measuring transmission and radiative capture. By comparing the ^{77}Se data with the Saclay results, it was found that the spin and neutron width values agree in the energy range up to 1.5 keV; however, the data in the 1.5 to 4 keV range indicated that the strength functions of the 2 spin states differ. It was concluded that in order to observe a difference of about 10% in the strength function, the effect of the transmission

must be measured with an error of less than 0.5%. Although not easy, these measurements may be carried out on the IBR reactor with injector by using polarized targets. (3 figures) (TTT)

Nuclear Properties and Reactions, 90 ≤ A ≤ 149

Refer also to abstracts 24708, 24772, 25605, 25630, 25679, 26070, 26089, 26091, 26102, 26126, 26130, 26139, 26143, 26144, 26150, 26154, 26156, 26164, 26248, 26250, 26255, 26275, 26280, 26290, 26294, 26301, 26320, 26327, 26369, 26382, and 26405.

26180 (CONF-720404-(Vol. 1), pp 206-225) MEAN L-SHELL X RAY FLUORESCENCE YIELDS FROM Z = 55 TO 65. Nix, D. W.; McGeorge, J. C.; Fink, R. W. (Georgia Inst. of Tech., Atlanta). Jan 1973.

From International conference on inner shell ionization phenomena and future applications; Atlanta, Georgia, USA (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

Mean L-shell x-ray fluorescence yields ($\bar{\omega}_L$) have been measured by observing K and L x-ray spectra of the daughters of ^{133}Ba, ^{137}Cs, ^{139}Ce, ^{141}Ce, and ^{159}Dy with high resolution Ge(Li) and Si(Li) x-ray detectors. Results at Z = 55, 56, 57, 59, and 65 are $\bar{\omega}_L$ = 0.089 ± 0.013, 0.093 ± 0.012, 0.110 ± 0.015, 0.123 ± 0.017, and 0.194 ± 0.027, respectively. A comparison with theory, based on subshell and Coster–Kronig yields and calculated L-subshell vacancy distributions in the respective radioactive decays, and with previous experiments will be presented. (auth)

26181 (CONF-720404-(Vol. 3), pp 1834-1842) ELECTRON DENSITIES AND CONVERSION COEFFICIENTS FOR Cs (Z = 55). Martin, B.; Schule, R. (Max-Planck-Institut fuer Kernphysik, Heidelberg). Jan 1973.

From International conference on inner shell ionization phenomena and future applications; Atlanta, Georgia, USA (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

Calculations of internal conversion coefficients (ICC) and of electron densities near the nucleus ($|\psi(0)|^2$) using different atomic models have been compared with conversion electron measurements of the 11.23 keV M1 transition in the decay of ^{134m}Cs. The measurements were carried out with the Heidelberg $\frac{1}{2}\pi\sqrt{13}$ iron-free β-ray spectrometer set for a momentum resolution of 0.1% till 0.5%. The multipolarity of the transition (M1 + 0.02% E2) has been deduced. The half-life of the isomeric state has been determined independently [$T_{\frac{1}{2}}$ = (2.95 ± 0.02)h]. (auth)

26182 (CONF-720404-(Vol. 3), pp 1844-1857) INTERNAL CONVERSION INVESTIGATIONS FOR THE 127.37 keV E3 TRANSITION. Martin, B.; Merkert, D. (Max-Planck Institut fuer Kernphysik, Heidelberg). Jan 1973.

From International conference on inner shell ionization phenomena and future applications; Atlanta, Georgia, USA (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

Relative conversion line intensities of the 127.37 keV E3 transition in ^{134}Cs have been measured for ten atomic subshells, using the $\frac{1}{2}\pi\sqrt{13}$ beta-ray spectrometer. The multipolarity E3 + (0.07 ± 0.04)% M4 was determined. Internal conversion coefficients were calculated in different physical approximations. Precise calculations were performed for three atomic models. Experimental data were found in agreement with recent tabulations and present calculations. An upper limit for the γ-branching ratio γ(138.6 keV M4)/γ(127.37 keV E3) was found to be 0.2%. For the half-life of the isomeric state we obtained (2.95 ± 0.02)h. (auth)

26183 (CONF-720404-(Vol. 3), pp 1868-1875) L- SUBSHELL, M- AND N-SHELL INTERNAL CONVERSION RATIOS OF THE 391.7 keV ISOMERIC TRANSITION OF ^{113}In. Koever, A.; Berenyi, D.; Csongor, J. (Inst. of Nuclear Research, Debrecen, Hungary). Jan 1973.

From International conference on inner shell ionization phenomena and future applications; Atlanta, Georgia, USA (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

The ratios of the conversion coefficients at the higher shells and subshells were measured in the 391.7 keV isomeric transition of ^{113}In. On the basis of the L subshell ratios it can be stated that the transition has an M4 character with a possible 8 per cent E5 admixture within the limit of error in the L subshell ratios. The L/M and M/N conversion ratios show a good agreement with the calculations of Hager and Seltzer and Dragoun et al. (auth)

26184 (CONF-720404-(Vol. 3), pp 1940-1947) DOUBLE INTERNAL CONVERSION. Briand, J. P.; Chevallier, P.; Johnson, A.; Rozet, J. P.; Tavernier, M.; Touati, A. (Univ., Paris). Jan 1973.

From International conference on inner shell ionization phenomena and future applications; Atlanta, Georgia, USA (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

For twenty years, many experiments have been performed about double quanta emission in the deexcitation of nuclear levels. This second order process, in quantum electrodynamic, has a very low probability and was, of course, searched in some isomeric levels whose deexcitation is very retarded. The usual technique of these experiments was to study the internal conversion of the two quanta and to search in coincidence the two emitted electrons or the two X rays following atomic rearrangement. We present in this paper some experiments, in which we have unambiguously observed the double internal conversion, using a new method based on the shifts we have previously observed, of the X rays coming from doubly ionized atoms in the same shell (hypersatellites). These experiments have been performed for various transitions as well as for very hindered transitions [190 keV E4 γ ray of ^{114}In], as for no retarded levels [280 keV E2 + M1 γ ray of ^{203}Hg and 145 keV M1 γ ray of ^{141}Ce]. The probabilities we observe for all these isotopes are roughly equal and are in good agreement with the shake-off probabilities calculated by Carlson. These experiments, which prove the existence of a double internal conversion, clearly indicate that this phenomenon cannot be satisfactorily explained by means of an internal conversion of two γ quanta, but by a direct interaction of the nuclear multipole on the whole atomic electrons. It is thus mainly a collective effect in the atom and not a peculiar electromagnetic interaction in the nucleus. (auth)

26185 (CONF-720404-(Vol. 3), pp 2005-2011) EJECTION OF ORBITAL ELECTRONS ACCOMPANYING THE ELECTRON CAPTURE DECAY OF ^{131}Cs. Sujkowski, Z.; Mysiek, B.; Lukasiak, J.; Kotlinska-Filipek, B. (Inst. of Nuclear Research, Swierk, Poland). Jan 1973.

From International conference on inner shell ionization phenomena and future applications; Atlanta, Georgia, USA (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

The energy spectrum of electrons ejected during the orbital electron capture decay of ^{131}Cs was measured in the energy range 80 keV ≤ E ≤ Q = 354 keV. The electrons are detected in a Si(Li) spectrometer placed in the homogeneous magnetic field. The intensity of electrons in the energy range considered is found to be (8.4 ± 1.5) × 10^{-7} per K-capture. This is considerably less than the theoretical value 15.5 × 10^{-7} calculated according to Primakoff and Porter and 34 × 10^{-7} obtained according to the nonrelativistic calculation of Stephas, but agrees well with the value 8.3 × 10^{-7} obtained according to Intemann. Comparison with the relevant data from other experiments is presented. (auth)

26186 (CONF-720404-(Vol. 3), pp 2141-2156) MEASUREMENT OF K-SHELL AUTOIONIZATION PROBABILITY IN THE β^- DECAYS OF ^{147}Pm, ^{151}Sm, ^{169}Er, ^{185}W, AND ^{210}Bi. Campbell, J. L.; Law, J.; McNelles, L. A. (Univ. of Guelph, Ont.). Jan 1973.

From International conference on inner shell ionization phenomena and future applications; Atlanta, Georgia, USA (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

The K shell auto-ionization probability P_{K_i} has been measured by Ge(Li) spectroscopy for β^- decays of widely differing endpoint energies. The method used did not involve electron counting, thus eliminating several sources of systematic error encountered in previous work. The P_K values agree well with the new theoretical predictions of Law and Campbell. (auth)

26187 (CONF-720404-(Vol. 3), pp 2157-2166) PHOTON SPECTRUM EMITTED IN THE DECAY OF ^{147}Pm. Hansen, H. H. (Central Bureau for Nuclear Measurements, Geel, Belgium). Jan 1973.

From International conference on inner shell ionization phenomena and future applications; Atlanta, Georgia, USA (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

The total photon spectrum from the decay of the β^--emitter ^{147}Pm has been measured with a high resolution Si(Li) detector. The ^{147}Pm decays mainly into the groundstate of ^{147}Sm, but also with a branch of $(6.0 \pm 0.6) \cdot 10^{-3}$% into its first excited level. This has been found from the measured γ-ray emission rate of $p_\gamma = (3.0 \pm 0.3) \cdot 10^{-5}$ γ-rays per disintegration and the theoretical conversion coefficients. The energy of the emitted γ-ray has been determined to be $E_\gamma = (121.10 \pm 0.14)$ keV. From the number of emitted K X-rays the total probability for internal ionization in the K-shell during β^--decay has been deduced as $p_k = (8.1 \pm 0.9) \cdot 10^{-5}$ per β^--particle. Finally the measured continuous bremsstrahlung spectrum has been compared with some photon distribution calculated on the basis of the classical theories. The part of internal bremsstrahlung has been deduced and some estimation for its probability has been made. (auth)

26188 (CONF-720404-(Vol. 3), pp 2167-2174) EXPERIMENTAL STUDY OF CONSECUTIVE INTERNAL IONIZATION IN β^- EMISSION FROM ^{90}Sr, ^{90}Y, AND ^{95}Nb. Legrand, J.; Blondel, M.; Brethon, J. (CEN, Saclay, France). Jan 1973. (In French).

From International conference on inner shell ionization phenomena and future applications; Atlanta, Georgia, USA (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

The variation of internal ionization intensity with energy is studied for beta decay of strontium-90, yttrium-90, and niobium-95. (JFP)

26189 (COO-1779-97) MICHIGAN STATE UNIVERSITY CYCLOTRON LABORATORY. Annual Report for the Period July 1, 1971–July 1, 1972. (Michigan State Univ., East Lansing. Cyclotron Lab.). Nov 1972. 165p. Dep. NTIS.

ALUMINUM-27—proton reactions (p,n) at 22 to 40 MeV, DWBA analysis of differential cross sections for, (E)
ANTIMONY-116—energy levels and transition branching ratios from tin-116 (p,nγ) reactions, (E)
ANTIMONY-118—energy levels from tin-118 (p,nγ) reactions, (E)
BARIUM-138—energy-level transitions in, shell-model calculations of, (T)
BERYLLIUM-7—proton reactions (p,γ) up to 1.3 MeV, calculation of excitation function for, (T)
CHLORINE-38—energy levels from chlorine-37 (d,p) reactions, shell-model calculations of spectroscopic factors and transition strengths of, (T)
CYCLOTRONS—development at Michigan State Univ., July 1, 1971–July 1, 1972
—experimental facilities at Michigan State Univ., developments at, July 1, 1971–July 1, 1972
EUROPIUM-142—beta and electron-capture decay of, gamma spectra from, (E)
EUROPIUM-143—beta and electron-capture decay of, branching ratios, gamma spectra, half-life, and log-ft and Q values for, (E)
GALLIUM-63—beta decay of, Kurie plot for, (E)
HAFNIUM-173—energy levels from tantalum-173 decay, lifetimes and spin–parity assignments for, (E)
—energy-level transitions from tantalum-173 decay, branching ratios and multipolarities for, (E)
HAFNIUM-177—energy levels from tantalum-177 decay, spin–parity assignments for, (E)
HELIUM-3—reactions (He-3,He-6) with A = 12 to 58 nuclei, cross sections for, (E)
HOLMIUM-165—proton reactions (p,t) with, DWBA analysis of angular distributions and spectrum from, (E)
LANTHANUM-139—energy levels and transitions in, shell-model calculations of, (T)
LEAD ISOTOPES—proton reactions (p,t) at 3 MeV, angular distributions and energy spectra from, (E)
MERCURY-199—energy levels from thallium-199 electron-capture decay, spin–parity assignments for, (E)
NEODYMIUM-142—energy levels from proton inelastic scattering at 30 MeV, (E)
NEON-24—energy levels and transitions in, shell-model calculations of, (E)
NICKEL-60—helium-3 elastic scattering at 71 MeV, optical-model analysis of angular distribution from, (E/T)
—proton reactions (p,d) at 35 MeV, differential cross sections for, (E)
NUCLEI—proton reactions with Z = 6 to 82, at 22 to 40 MeV, yields of compound and direct neutrons in, (E)
NUCLEI, EVEN–EVEN—moment of inertia of A = 154 to 182, (E)
NUCLEI, LIGHT—proton reactions with A = 12 to 27, precise Q values for, (E)
—nuclear magnetic dipole moments of A = 6 to 14, calculations using effective interaction, (T)
—mass multiplets of A = 25 and 37, (E)
POTASSIUM-38—energy levels from potassium-39 (p,d) reactions, (E)
POTASSIUM-40—energy-level transitions in, shell-model calculations of strengths of, (T)
PRASEODYMIUM-140—energy levels and transitions from cerium-140 (p,nγ) and praseodymium-141 (p,d) reactions, (E)
PROMETHIUM-141—energy level at 628.7 keV from samarium-141 decay, lifetime of, (E)
—energy levels and transitions from samarium-141 decay, branching ratios and spin–parity assignments for, (E)
PROMETHIUM-143—energy-level transitions from samarium-143 decay, branching ratios for, (E)
RAD. DET, PROPORTIONAL—design and performance of position-sensitive
SAMARIUM-141—beta and electron-capture decay of, branching ratios, gamma spectra, and log-ft values for, (E)
SAMARIUM-143—beta and electron-capture decay of, branching ratios, gamma spectra, half-life, and log-ft and Q values for, (E)
—energy-level transitions from europium-143 decay, branching ratios for, (E)
SCANDIUM-45—alpha reactions (α,nγ) at 12.0 MeV, gamma spectra from, (E)
SILICON-30—proton reactions (p,d) at 35 MeV, j dependence in angular distributions from, (E)
TANTALUM-173—beta and electron-capture decay of, branching ratios, gamma spectra, half-life, and log-ft and Q values for, (E)
TANTALUM-177—beta and electron-capture decay, gamma spectra from, (E)
THALLIUM-199—electron-capture decay of, branching ratios, gamma spectra, and log-ft values for, (E)
TIN-116—proton reactions (p,nγ) with, gamma singles and coincidence spectra from, (E)
TIN-118—proton reactions (p,nγ) with, gamma singles and coincidence spectra from, (E)
TITANIUM-48—proton reactions (p,nγ) at 4.81 to 7.03 MeV, excitation functions and gamma spectra from, (E)
TUNGSTEN-179—energy levels from hafnium-177 (α,2nγ) reactions, spin–parity assignments for, (E)
TUNGSTEN-181—energy levels from hafnium-180 (α,3nγ) reactions, spin–parity assignments for, (E)
VANADIUM-48—energy-level transitions from titanium-48 (p,nγ) reactions, branching and mixing ratios for, (E)
—energy levels from scandium-45 (α,nγ) and titanium-48 (p,nγ) reactions, spin–parity assignments for, (E)
VANADIUM-51—helium-3 elastic scattering at 70 MeV, optical-model analysis of angular distribution from, (E/T)
—proton reactions (p,n) at 22 to 40 MeV, DWBA analysis of differential cross sections for, (E)
ZIRCONIUM-90—proton reactions (p,n) at 22 to 40 MeV, DWBA analysis of differential cross sections for, (E) (RWR)

26190 (GSI-72-4) CONSIDERATIONS CONCERNING THE EXPERIMENTAL RESEARCH PROGRAM 1972–1974. (Gesellschaft fuer Schwerionenforschung, Darmstadt (West Germany)). Feb 1972. 49p. (In German). INIS.

The main topics of the planned research work with the heavy ion accelerator are superheavy nuclei and elements, decay properties of nuclei near the stability region, nuclear reactions and nuclear fission, Coulomb excitation, and nuclear physics. (INIS)

26191 (INIS-mf-328) THEORETICAL STUDY OF THE STRUCTURE AND THE ELECTROMAGNETIC PROPERTIES OF ODD–EVEN ANTIMONY NUCLEI. Vanden Berghe, G. J. C. (Ghent Rijksuniversiteit (Belgium)). 1971. 121p. (In Dutch). INIS.

Thesis.

Different approximations to describe the energy levels and the electromagnetic properties of nuclei are given. The depth of the Woods–Saxon potential describing the behaviour of the extra proton in odd–even antimony nuclei is determined. The electromagnetic operators are formed; and the transition probability and branching ratios calculated. (INIS)

26192 (JINR-P4-6912) COUPLING OF COLLECTIVE AND QUASIPARTICLE EXCITATIONS IN EVEN–EVEN SPHERICAL NUCLEI. Vdovin, A. I.; Stoyanov, Ch. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 19p. (In Russian). Dep. NTIS (U.S. Sales Only) $3.00.

The effect of coupling of two-quasi-particle and phonon excitations on the structure of a number of 4^+ and 5^- states of even–even semimagic nuclei is studied in the framework of the "pairing + multipole–multipole forces" model by using the quasi-boson approximation. Energies, wave functions, and $B(E2,4^+ \rightarrow 2^+)$ values for these states are calculated for a series of isotopes of S_n and isotones with neutron number N = 50, 82. (auth) (3 tables)

26193 (KFK-1715) COLLECTIVE ENERGY SURFACES OF EVEN–EVEN NUCLEI IN THE MASS REGION WITH 50 < (N,Z) < 82. Habs, D.; Klewe-Nebenius, H.; Loehken, R.; Nowicki, G.; Rebel, H.; Wisshak, K. (Kernforschungszentrum, Karlsruhe (West Germany). Zyklotron–Laboratorium). Dec 1972. 38p. (In German). Dep. NTIS (U.S. Sales Only) $4.00.

For the nuclei ^{120,122,124,126,128,130}Te, ^{126,128,130,132,134}Xe, ^{128,130}Ba, ^{132,134,136}Ba, ^{136,138}Ce, ^{138,140}Nd and ^{142}Sm potential energy surfaces were calculated by fitting experimental data within the Greiner–Gneuss model. From the calculations predictions of unknown energy levels, B(E2) values, and quadrupole moments were obtained. (auth) (27 figures, 4 tables)

26194 (ORNL-TM-4167) THEORETICAL AND PRACTICAL SPECIFIC ACTIVITIES AND OTHER PROPERTIES OF COMMON RADIONUCLIDES. Reynolds, S. A. (Oak Ridge National Lab., Tenn.). Mar 1973. Contract W-7405-eng-26. 16p. Dep. NTIS $3.00.

Half-lives were carefully selected, and specific activities were calculated for 161 commonly used radioisotopes with half-lives greater than 12 h. Practical specific activities of many bombardment products are listed, based where applicable upon critically evaluated neutron cross sections and fission yields, as well as analytical data. Up-to-date decay parameters for a number of additional nuclides are given. The information can be applied by manufacturers and users of radioisotope materials, radiochemical analysts, and others. (2 tables) (auth)

26195 DECAY OF ^{149}Tb. I. The spectra of γ-rays and conversion electrons. Vylov, Ts.; Gromov, K. Ya.; Gromova, I. I.; (and others) Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 10, 2118-2123(Oct 1972). (In Russian).

The spectra of γ rays and conversion electrons from the decay of ^{149}Tb ($T_{½}$ = 4.1 hr) were investigated using Ge(Li) and Si(Li) detectors, respectively. More than 80 new transitions were detected. The radioisotope of Tb was prepared by 660-MeV-proton bombardment of Ta with a synchrocyclotron. The energies and relative intensities of ^{149}Tb γ radiation and the experimental vs theoretical values of α_K for ^{149}Gd transitions are tabulated. (4 tables) (KSW)

26196 DECAY OF ^{149}Tb. II. Study of $\gamma\gamma$ coincidence spectra. Decay scheme of ^{149}Tb → ^{149}Gd. Vylov, Ts.; Gromov, K. Ya.; Gromova, I. I.; (and others) Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 10, 2124-2127(Oct 1972). (In Russian).

The γ–γ coincidence spectra of excited states of ^{149}Gd from the decay of the isotope ^{149}Tb were studied, and the decay scheme for this conversion was constructed. A comparison was made of the excited states of ^{147}Sm, ^{149}Gd, and ^{151}Gd. (2 figures, 1 table) (KSW)

26197 COULOMB EXCITATION OF THE NUCLEAR LEVELS OF ^{113}Cd. Andreev, D. S.; Grinberg, A. P.; Erokhina, K. I.; Zvonov, V. S.; Lemberg, I. Kh. (Ioffe Inst. of Physics and Tech., Leningrad). Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 10, 2172-2174(Oct 1972). (In Russian).

An investigation of the Coulomb excitation of ^{113}Cd was conducted with a modern γ spectrometer with a Ge(Li) detector. Excitation was obtained by bombarding metallic Cd (90.2% ^{113}Cd) with 12.4-MeV α particles and with ^{12}C ions of 35.3 and 41.1 MeV energies. An energy-level diagram was constructed for ^{113}Cd shqwing only levels with positive parity and with energy not exceeding 988.7 keV. (1 figure, 1 table) (KSW)

26198 PROTON REACTIONS ON TELLURIUM ISOTOPES AND THE INVESTIGATION OF ISOBARIC ANALOG STATES OF IODINE NUCLEI. Bangert, R.; Gonsior, B.; Mur, G.; (and others) (Univ., Kiel). Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 10, 2213-2224 (Oct 1972). (In Russian).

The low-lying isobaric-analog resonances of negative parity were studied for odd isotopes of iodine by using elastic and inelastic scattering of protons by even isotopes of tellurium. (10 figures) (tr-auth)

26199 NUCLEAR STRUCTURE STUDIES USING NUCLEON AND DEUTERON SCATTERING. Nemets, O. F.; Sokolov, L. S. (Inst. of Nuclear Research, Kiev). Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 10, 2036-2051(Oct 1972). (In Russian).

The nature of low-lying excited states of intermediate nuclei was elucidated with the help of nucleons and deuterons of intermediate energy. Elastic and inelastic scattering by ^{60}Ni (13.6-MeV deuterons), ^{48}Ti (14.5-MeV neutrons and 13.6-MeV deuterons), ^{112,114}Cd (13-MeV protons), and ^{110}Pd (13-MeV protons) were calculated using vibrational and Davydov–Chaban models, with good reproduction of the experimental work of other authors. (7 figures, 4 tables) (KSW)

26200 ALPHA PICKUP IN THE A = 90 REGION. Detraz, C. (Paris Univ., Orsay, France); Zafiratos, C. D.; Rudolph, H.; Zaidins, C. S. J. Phys. (Paris), Colloq.; No. 5, 81(1972).

The (^{3}He,^{7}Be) reaction on ^{92}Zr and ^{93}Nb was studied using a 41.3 MeV ^{3}He beam. The cross sections are half the size of those of ^{40}Ca and larger than those of ^{58}Ni. The variation of the cross section with the mass of the target nucleus appears to result from two opposite effects: a reduction in the radius, causing a sharp reduction in the cross section due to increased absorption; an increase in the number of modes of the α bound-state wave function, tending to increase the cross section. (FR)

26201 LEVEL PROPERTIES IN THE EVEN—EVEN NUCLEI ^{130}Ce, ^{132}Ce, AND ^{134}Ce. FURTHER EVIDENCE FOR THE BACK BENDING EFFECT. Taras, P.; Dehnhardt, W.; Mills, S. J.; Merdinger, J.; Neumann, U.; Veggian, M.; Povh, B. (Max-Planck-Institut fuer Kernphysik, Heidelberg). J. Phys. (Paris), Colloq.; No. 5, 102(1972).

High-spin members of the ground-state rotational bands in the doubly-even nuclei ^{130}Ce, ^{132}Ce, ^{134}Ce have been populated with the (^{16}O,4n) reaction at 76 MeV. Level lifetimes were measured via the Doppler-shift recoil distance method; and for ^{132}Ce, the spin sequence up to $J = 14^+$ and possibly 16^+ was investigated. The results of the lifetime measurements, together with the B(E2) values for the 2^+, 4^+ and 6^+ levels, are given. (FR)

26202 DETERMINATION OF NEUTRON DISTRIBUTION RADII BY ALPHA-PARTICLE ELASTIC SCATTERING. Brissaud, I.; Bimbot, L.; Le Bornec, Y.; Tatischeff, B.; (Paris Univ., Orsay, France). J. Phys. (Paris), Colloq.; No. 5, 158 (1972).

Elastic scattering cross sections were measured for 166-MeV α particles on ^{24}Mg, ^{28}Si, ^{40}Ca,-^{60}Ni, ^{90}Zr, ^{92}Mo, ^{120}Sn, and ^{208}Pb. Neutron distribution radii obtained for a Woods–Saxon potential are presented. (FR)

26203 COMPOUND NUCLEUS REACTIONS INDUCED BY HIGH-ENERGY ARGON IONS ON Sn, Sb, I, AND Cs TARGETS. Gauvin, H.; Le Beyec, Y.; Porile, N. T. (Paris Univ., Orsay, France). J. Phys. (Paris), Colloq.; No. 5, 92(1972). (In French).

The excitation functions for the following reactions are given: (Ar,xn) and (Ar,pxn) for x = 5 to 8, (Ar,2pxn) for x = 7, 11, 12 and (Ar,3pxn) for x = 11 and 12. These reactions were induced on ^{118}Sn, ^{121}Sb, ^{123}Sb and ^{127}I using 200 to 300 MeV bombardment energies. (FR)

26204 STUDY OF 30 MeV PROTON INELASTIC SCATTERING FROM ISOTOPES OF MOLYBDENUM AND ZINC. Tait, W. H. (Polytechnic, London); Edwards, V. R. W. Nucl. Phys.; A203: No. 1, 193-208(1973).

Proton inelastic scattering cross sections and analyzing powers were measured at 30 MeV for the first 2^+ and 3^- states of several isotopes of molybdenum and zinc. A DWBA analysis of the data is presented, with emphasis on the treatment of the deformed spin–orbit potential and the use of microscopic models. It is concluded that an accurate treatment of the deformed spin–orbit interaction gives a worthwhile improvement to most of the analyzing power fits. In addition, information was extracted on the variation of the effective nucleon–nucleon force as one passes through the Mo isotopes from ^{92}Mo, which has a small β, to the strongly collective ^{100}Mo. (8 figures, 5 tables) (auth)

26205 INTERFACE OF THEORY AND EXPERIMENT IN NUCLEAR SPECTROSCOPY. Rasmussen, J. (Yale Univ., New Haven). pp 3-19 of Radioactivity in Nuclear Spectroscopy. Vol. I. Hamilton, J. H. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From International Conference on Radioactivity in Nuclear Spectroscopy; Nashville, Tennessee, United States of America (USA) (11 Aug 1969). See CONF-690818-(Vol.1).

Nature made atomic nuclei in sufficient variety and complexity that neither theory alone nor experiment alone can make more than limited progress in achieving understanding. The traditional interface has had important components: the periodic nuclear data compilations, the regular journal publications and abstracting, plus meetings, seminars, and individual contacts. Now at the very time that technological advances offer gamma-ray and charged-particle spectroscopic data of spectacular resolution and quantity, the traditional interface mechanisms to theory or even to permanent recording of results seem drastically inadequate. Satis-

factory and sufficient answers to the challenge of the new experimental capabilities are not easy to come by, but it seems clear that the following steps are needed: computerized data compilations, capable not only of producing standardized tables, but of making specialized data searches or sorts for theorists or experimentalists; standardized shared computer program libraries for theoretical and data analysis routines; and modes of cataloging nuclear spectroscopic data—where a complete decay scheme, full comparison with theory, and so on, has not or cannot be done, a sort of General Star Catalog for all precisely measured gamma rays or conversion lines. These measures are needed not only to maximize the availability of the modern high-quality data to theorists, but also to interface experimental groups in various laboratories better to one another. There is much need for collaborative and complementary measurements of nuclear levels by all possible modes of radioactive decay and nuclear reactions that will populate them. It is to be hoped that this conference can stimulate thought and action to strengthen and modernize the interfaces of nuclear experiment to experiment and experiment to theory. (auth)

26206 LEVELS IN ^{145}Eu. Toth, K. S.; Newman, E.; Wildenthal, B. H.; (and others) (Oak Ridge National Lab., TN). pp 369-379 of Radioactivity in Nuclear Spectroscopy. Vol. I. Hamilton, J. H. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From International Conference on Radioactivity in Nuclear Spectroscopy; Nashville, Tennessee, United States of America (USA) (11 Aug 1969). See CONF-690818-(Vol.1).

Levels in ^{145}Eu were investigated by the ^{144}Sm (^{3}He,d) reaction and by the decay of 25-min ^{145}Gd. At the ^{3}He energy used, i.e., 40.33 MeV, the angular distributions for the stripping reaction were found to be highly structured; this fact permitted reliable assignments of transferred orbital angular momenta to the residual levels. Singles γ-ray spectra for the decay of ^{145}Gd were measured with a 20-cm^3 Ge(Li) detector. The two sets of experimental data were then used to propose the following sequence of ^{145}Eu levels: 0 ($5/2^+$), 330.1 ($7/2^+$), 716 ($11/2^-$), 808.4 ($1/2^+$), 1041.9 ($3/2^+$), 1599.9 ($7/2^+$), 1757.9 ($3/2^+$), 1844.7 ($3/2,5/2^+$), 1880.6 ($1/2,3/2^+$), 2112.0 ($3/2,5/2^+$), and a possible ($1/2^+$), ($3/2,5/2^+$) doublet at ~2480 keV. The salient features of this level scheme are that the (^{3}He,d) reaction predominantly populates the first five energy levels, and the decay from ^{145}Gd ($1/2,3/2^+$) proceeds mainly to the levels at 1757.9 and 1880.6 keV and not to the single-particle states at 808.4 and 1041.9 keV. The second point is puzzling because strong direct decay to the single-particle states is energetically favored and has indeed been observed in connection with decay to neighboring 82-neutron nuclei. (2 figures) (auth)

26207 MEASUREMENTS OF NUCLEAR HALF-LIVES ≤1 SEC. Loebner, K. E. G. (Univ., Munich). pp 489-547 of Radioactivity in Nuclear Spectroscopy. Vol. I. Hamilton, J. H. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From International Conference on Radioactivity in Nuclear Spectroscopy; Nashville, Tennessee, United States of America (USA) (11 Aug 1969). See CONF-690818-(Vol.1).

A review of the different methods to measure nuclear half-lives $T_{\frac{1}{2}} \leq 1$ s is presented. The most important of these methods are as follows: measurements which determine the nuclear level width—Moessbauer effect and nuclear resonance fluorescence; measurements of the Coulomb excitation cross section, which is proportional to the reduced electric gamma-ray transition probability; measurements which are based on the Doppler shift of gamma-rays emitted from recoiling nuclei after a nuclear reaction—the recoil-distance method and the Doppler-shift-attenuation method; delayed coincidence measurements; and direct decay measurements. The principles, the applicability, and the limits of these methods are described, with some emphasis on delayed coincidence measurements. Finally, the significance of half-life measurements in comparing experimentally determined absolute gamma-ray transition probabilities with theoretical values of different nuclear models is discussed. (14 figures, 1 table, 172 references) (auth)

26208 METHOD FOR NUMERICAL CONSTRUCTION OF LEVEL SCHEMES. Baecklin, A. (Swedish Research Councils' Lab., Studsvik). pp 651-673 of Radioactivity in Nuclear Spectroscopy. Vol. II. Hamilton, J. H. (Ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From International Conference on Radioactivity in Nuclear Spectroscopy; Nashville, Tennessee, United States of America (USA) (11 Aug 1969). See CONF-690818-(Vol. 2).

A computerized procedure for construction of energy-level diagrams is presented. The procedure consists of two steps. The first step uses the program NUCLEV to deduce possible levels from experimentally observed transition energies and values corresponding to already known levels. Due to the finite experimental errors of all energy values involved there is always a certain probability that a level candidate deduced from energy combinations is due to accidental combinations. The program PNAC estimates the probabilities that the possible levels deduced by NUCLEV are purely accidental. The main features of the programs are described and illustrated by application to levels in ^{189}Ir and ^{149}Pm. The FORTRAN IV listings of the programs are given in the appendix. (4 figures, 2 tables) (RWR)

26209 K-CAPTURE BRANCH IN THE DECAY OF ^{113m}In. Ramaswamy, M. K. (Brookhaven National Lab., Upton, NY). pp 1211-1218 of Radioactivity in Nuclear Spectroscopy. Vol. II. Hamilton, J. H. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From International Conference on Radioactivity in Nuclear Spectroscopy; Nashville, Tennessee, United States of America (USA) (11 Aug 1969). See CONF-690818-(Vol. 2).

26210 NOTE ON THE DECAY OF ^{114}In AND THE ALLOWED LOG FT. VALUES. Coffman, F. E.; Hamilton, J. H. (Vanderbilt Univ., Nashville). pp 1219-1220 of Radioactivity in Nuclear Spectroscopy. Vol. II. Hamilton, J. H. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From International Conference on Radioactivity in Nuclear Spectroscopy; Nashville, Tennessee, United States of America (USA) (11 Aug 1969). See CONF-690818-(Vol.2).

26211 ^{127}I LEVELS POPULATED BY ^{127m}Te DECAY. Graham, R. L.; Geiger, J. S. (Atomic Energy of Canada Ltd., Chalk River, Ont.). pp 1221-1223 of Radioactivity in Nuclear Spectroscopy. Vol. II. Hamilton, J. H. (Ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From International Conference on Radioactivity in Nuclear Spectroscopy; Nashville, Tennessee, United States of America (USA) (11 Aug 1969). See CONF-690818-(Vol. 2).

26212 STUDIES OF NON UNIQUE AND UNIQUE FIRST FORBIDDEN BETA TRANSITIONS. Krmpotic, F. (Univ. Nacional de La Plata); Bosch, H. E.; Behar, M.; (and others). pp 1301-1305 of Radioactivity in Nuclear Spectroscopy. Vol. II. Hamilton, J. H. (Ed.). New York; Gordon and Breach Publishers, Inc. (1972).

From International Conference on Radioactivity in Nuclear Spectroscopy; Nashville, Tennessee, United States of America (USA) (11 Aug 1969). See CONF-690818-(Vol. 2).

26213 INTERNAL CONVERSION RATIOS FOR THE HIGHER SHELLS IN THE DECAY OF ^{131m}Xe. Illes, F.; Ujhelyi, C.; Juhasz, S. (Inst. of Nuclear Research, Debrecen, Hungary). pp 1349-1355 of Radioactivity in Nuclear Spectroscopy. Vol. II. Hamilton, J. H. (Ed.). New York; Gordon and Breach Publishers, Inc. (1972).

From International Conference on Radioactivity in Nuclear Spectroscopy; Nashville, Tennessee, United States of America (USA) (11 Aug 1969). See CONF-690818-(Vol. 2).

26214 K-CONVERSION COEFFICIENT FOR THE 37.15 keV M1 TRANSITION IN ^{121}Sb. Sastry, K. S. R. (Univ. of Massachusetts, Amherst); Wood, R. E.; Palms, J. M.; Rao, P. V. pp 1375-1379 of Radioactivity in Nuclear Spectroscopy. Vol. II. Hamilton, J. H. (Ed.). New York; Gordon and Breach Publishers, Inc. (1972).

From International Conference on Radioactivity in Nuclear Spectroscopy; Nashville, Tennessee, United States of America (USA) (11 Aug 1969). See CONF-690818-(Vol. 2).

26215 SEARCH FOR 0^+ AND 3^- LEVELS IN ^{132}Xe. Carter, H. F. (Furman Univ., Greenville, S. C.). Brantley, W. H.; Manthuruthil, J. C.; Pinajian, J. J. pp 1381-1386 of Radioactivity in Nuclear Spectroscopy. Vol. II. Hamilton, J. H. (Ed.). New York; Gordon and Breach Publishers, Inc. (1972).

From International Conference on Radioactivity in Nuclear Spectroscopy; Nashville, Tennessee, United States of America (USA) (11 Aug 1969). See CONF-690818-(Vol. 2).

26216 ACOUSTICAL PERTURBATION OF ANGULAR CORRELATIONS. Gelberg, A. (Inst. for Atomic Physics, Bucharest). pp 1475-1479 of Radioactivity in Nuclear Spectroscopy. Vol. II. Hamilton, J. H. (Ed.). New York; Gordon and Breach Publishers, Inc. (1972).

From International Conference on Radioactivity in Nuclear Spectroscopy; Nashville, Tennessee, United States of America (USA) (11 Aug 1969). See CONF-690818-(Vol. 2).

26217 g-FACTOR OF THE ^{123}Te FIRST EXCITED STATE. Rots, M.; Van Esch, R.; Coussement, R. (Univ., Louvain, Belg.). pp 1491-1497 of Radioactivity in Nuclear Spectroscopy. Vol. II.

Hamilton, J. H. (Ed.). New York; Gordon and Breach Publishers, Inc. (1972).

From International Conference on Radioactivity in Nuclear Spectroscopy; Nashville, Tennessee, United States of America (USA) (11 Aug 1969). See CONF-690818-(Vol. 2).

26218 STUDY BY ELECTRON SCATTERING OF THE COLLECTIVE STATES OF EVEN–EVEN NUCLEI HAVING A FILLED SHELL. Phan Xuan Ho; Bellicard, J. B.; Leconte, P.; Sick, I. (CEN de Saclay, Gif sur-Yvette, France). J. Phys. (Paris), Colloq.; No. 5, 167(1972). (In French).

Electron scattering techniques were used to study the first collective levels of even–even nuclei having a filled neutron or proton shell. The measurements were made to verify the vibrational properties established from microscopic models of the nucleus in the framework of the RPA. The angular distributions of the cross sections for the 2^+ and 3^- levels of ^{92}Mo are presented. (FR)

26219 AVERAGE RESONANCE SPECTROSCOPY IN TECHNETIUM-93, TECHNETIUM-95, AND TECHNETIUM-97. Close, D. A. Lawrence, KS; Univ. of Kansas (1972). 164p. University Microfilms Order No. 72-32,871.

THESIS (PH. D.).

The (p,γ) reactions on the ^{92}Mo, ^{94}Mo, and ^{96}Mo isotopes were studied in the energy range E_p = 2.4 to 3.0 MeV by using a single Ge(Li) detector, a Ge(Li) detector incorporated into a three-crystal pair spectrometer, and a Ge(Li) detector in coincidence with a NaI(Tl) detector. The average total cross sections were 4.9 ± 2.1 μb, 5.7 ± 2.5 μb, and 1.9 ± 0.8 μb for the ^{92}Mo(p,γ_1)^{93}Tc, ^{94}Mo(p,γ_1)^{95}Tc, and ^{96}Mo(p,γ_1)^{97}Tc reactions, respectively. For each of the three targets a three-crystal pair spectrometer was utilized to determine the average yield of gamma rays leading directly to the low-lying states in the three residual nuclei. These average yields were examined for a possible correlation between the intensity of the high-energy gamma-ray transitions and the J^π of the final state. The data support a J-dependence hypothesis. A two-dimensional coincidence experiment determined the decay scheme of the low-lying states in ^{93}Tc, ^{95}Tc, and ^{97}Tc. The J^π assignments inferred from this experiment are consistent with those already obtained. For other states the results of this experiment are as follows (all energies are in keV): ^{93}Tc: 680 ($7/2^+$), 1193 ($5/2^+$), 1406 ($1/2^-$, $3/2^-$), 1555 ($1/2^-$, $3/2^-$), 2429 ($\leq 5/2$); ^{95}Tc: 1278 ($3/2^+$), 1619 ($3/2^+$, $5/2^-$), 2556 ($\geq 5/2$); and ^{97}Tc: 948 ($1/2^-$, $3/2^-$), 1060 ($5/2^\pm$, $7/2^+$), 1138 ($5/2^\pm$), 1366 ($3/2^+$), 1387 ($3/2^+$, $5/2^\pm$), 1517 ($1/2^-$, $3/2^-$), 1573 ($3/2^+$, $5/2^\pm$), 1676 ($3/2^+$, $5/2^\pm$). (Diss. Abstr. Int., B.)

26220 QUADRUPOLE MOMENTS OF NUCLEAR EXCITED STATES MEASURED BY THE REORIENTATION EFFECT IN COULOMB EXCITATION. Christy, A. (Queen's Univ., Kingston, Ont.); Haeusser, O. Nucl. Data, Sect. A; 11: No. 4, 281–298 (1973).

Adopted values for the static charge quadrupole moments, Q_{2+}, of first excited states of even–even nuclei are given. Also listed are adopted values of the reduced electromagnetic transition probabilities, B(E2, $0^+ \rightarrow 2^+$), and the corresponding values, $|Q^{2+}_{rot}|$, derived with the adiabatic rotational model. The individual measurements of Q_{J^π} on which the above values are based are tabulated. In cases where several measurements of a certain quadrupole moment are available, average values were adopted. The literature survey for this work was completed by March 1972. The values of Q_{2+} and of $|Q^{2+}_{rot}|$ are presented in graphical form as a function of atomic number. Both quantities give a good indication of the type and extent of collective features in even–even nuclei. (2 figures, 2 tables) (auth)

26221 NUCLEAR SPINS OF NEUTRON-DEFICEINT PROMETHIUM, SAMARIUM, EUROPIUM, AND GADOLINIUM ISOTOPES. Ekstroem, C.; Ingelman, S.; Olsmats, M.; Wannberg, B. (Uppsala Univ.). Phys. Scr.; 6: No. 4, 181–190(1972).

Spin measurements have been performed on some neutron-deficient promethium, samarium, europium and gadolinium isotopes using conventional atomic-beam magnetic resonance techniques. The results are as follows: ^{141}Pm (20.9 min) I = $5/2$, ^{140}Sm (14.8 min) I = 0, ^{141}Sm (11.3 min) I = $1/2$, ^{141m}Sm (22.9 min) I = $11/2$, ^{142}Sm (72.5 min) I = 0, ^{143}Sm (8.8 min) I = $3/2$, ^{145}Eu (5.93 d) I = $5/2$, ^{146}Eu (4.65 d) I = 4, ^{147}Eu (22 d) I = $5/2$, ^{148}Eu (54 d) I = 5, ^{149}Eu (93.1 d) I = $5/2$, ^{150}Eu (12.6 h) I = 0, ^{145}Gd (22.9 min) I = $1/2$, ^{147}Gd (38.5 h) I = $7/2$, ^{149}Gd (9.4 d) I = $1/2$, ^{151}Gd (120 d) I = $1/2$. The investigated nuclei appear close to the shell closure at neutron number N = 82. A systematic review of the low-lying states of odd–even and doubly odd nuclei in this region is presented. (auth)

26222 TABLES OF γ RAYS. Volume I. Sangiust, V.; Terrani, M. Milan; Politecnico di Milano (1971). 157p.

A compilation of γ rays from the decay of fission products and nuclides produced by (n,γ) reactions with half-lives between 0.1 s and 10^7 y is presented. The γ rays are arranged in order of photon energy; column headings of the table are energy, nuclide, half-life, absolute abundance, relative abundance, and means of production. A table with the nuclides arranged according to atomic number is presented in volume II. (RWR)

26223 TABLES OF γ RAYS. Volume II. Sangiust, V.; Terrani, M. Milan; Politecnico di Milano (1971). 193p.

A compilation of γ rays from the decay of fission products and nuclides produced by (n,γ) reactions is presented. The radionuclides are arranged according to atomic number (and secondarily by mass number). Energy, absolute and relative abundances, half-lives, means of production, and indication of possible radiation from decay products are given. A more complete introduction is found in volume I. (RWR)

26224 OPTICAL MODEL ANALYSIS OF TOTAL NEUTRON CROSS-SECTIONS OF Pr. Enayetullah, M.; Rahman, M. (Atomic Energy Centre, Dacca, Bangladesh). J. Nucl. Energy; 27: No. 2, 123-125(Feb 1973).

An optical model for the total neutron cross-section of Pr in the range 0.5–18.0 MeV is described. The programme was tested using different sets of parameters used by other workers. The best fit curve is compared with experimental results from various laboratories. (UK)

26225 (n,2n) CROSS-SECTIONS ON Nb AND Mo NUCLEI. Jeki, L.; Kluge, G. (Kozponti Fizikai Kutato Intezet, Budapest). J. Nucl. Energy; 27: No. 2, 115-118(Feb 1973).

Two methods of estimating cross-sections of (n,2n) reactions for Nb and Mo are presented. They show good agreement and confirm a previous estimate for the Nb(n,2n) cross-section at 14 MeV. It is also shown that reasonable data on the energy distribution of neutrons in the (n,n') and (n,2n) reactions can be obtained from recently proposed calculation methods. (UK)

26226 PHOTOPRODUCTION OF ^{102}Rh ($t_{\frac{1}{2}}$ 2.9 y), ^{101}Rh ($t_{\frac{1}{2}}$ 3 y), AND ^{88}Y FROM ^{103}Rh FOR PHOTON ENERGIES RANGING BETWEEN 0.4 AND 0.9 GeV. Aurisicchio, C.; di Napoli, V.; Salvetti, F.; Terranova, M. L. (Univ., Rome). Gazz. Chim. Ital.; 102: No. 4, 378-386(1972).

Measurements of σ_Q (cross section per equivalent quantum) and $\overline{\sigma}_k$ (average absolute cross section) are reported for the reactions ^{103}Rh (γ,n)^{102}Rh ($t_{\frac{1}{2}}$ = 2.9 y), ^{103}Rh(γ,2n)^{101g}Rh, and ^{103}Rh(γ,6p9n)^{88}Y in the energy range 0.4 to 0.9 GeV. The cross section values ($\overline{\sigma}_k$) found are (1.2 ± 0.5) mb, (4.0 ± 0.6) mb, and (36 ± 0.6) mb, respectively, for the three reactions. These values have been compared with those of a previous paper for the reactions ^{103}Rh(γ,n)^{102}Rh ($t_{\frac{1}{2}}$ = 206 d) and ^{103}Rh(γ,2n)^{101m}Rh. (7 figures, 4 tables) (auth)

26227 ISOMER RATIOS OF Tc ISOTOPES PRODUCED IN 10 TO 65 MeV BOMBARDMENTS OF ^{96}Mo. Hogan, J. J. (McGill Univ., Montreal). J. Inorg. Nucl. Chem.; 35: No. 3, 705-712 (Mar 1973).

Cross-sections and isomer ratios have been measured for three related nuclear reactions over the proton bombarding energy region from 10 to 65 MeV. The (p, 2 to 4n) reactions on enriched ^{96}Mo produce the isomeric pairs ^{93m,g}Tc, ^{94m,g}Tc and ^{95m,g}Tc. Experimental results are discussed and interpreted in terms of the changing production mechanism for the reactions over this range of bombarding energies. (auth)

26228 ISOTOPE EFFECTS IN THE NUCLEAR CHARGE-DISTRIBUTION IN TIN. Silver, J. D.; Stacey, D. N. (Oxford Univ.). Proc. Roy. Soc. (London), Ser. A; 332: No. 1588, 139-150(6 Feb 1973).

The information at present available concerning isotope effects in the nuclear charge distribution in the ground state for the abundant isotopes of tin is discussed. Inclusion of recent spectroscopic data leads to new results for the changes in mean square radius $\delta\langle r^2\rangle$ over this range of nuclei: 116 to 117, 0.049; 116 to 118, 0.124; 118 to 119, 0.044; 118 to 120, 0.112; 120 to 122, 0.101; 122 to 124, 0.091 (all in square femtometres). The error in all cases is estimated ±7%. These values are on average less than half those calculated assuming incompressible nuclear matter, and for the even isotopes decrease regularly with mass number. A comparison of electronic and muonic isotope shift measurements in terms of a two-parameter Fermi distribution of nuclear charge shows that the smallness of $\delta\langle r^2\rangle$ may be due to changes occurring in the surface region of the nucleus, the nucleon density in the central region remaining approximately constant. This result is consistent with data from electron scattering experiments. The contributions to $\delta\langle r^2\rangle$ due to changes in nuclear deformation are evaluated. (auth)

26229 INTERFERENCE EFFECTS IN CROSS SECTIONS CALCULATED BY PHOTON DIFFERENCE METHODS. Dahmen, H. (Univ., Heidelberg); Dreyer, F.; Crawford, D. M.; Thies, H. H. Nucl. Instrum. Methods; 107: No. 2, 329-332(1973).

The photon difference-type calculation transforms the photonuclear yield into the corresponding cross section. For a cross section containing very narrow resonances, approximations in the transformation calculation can simulate interference-like effects in the derived cross section; these effects can be caused by truncation errors and by the use of an incorrect bremsstrahlung spectrum. (auth)

26230 INTERACTION OF FAST DEUTERONS WITH ATOMIC NUCLEI. Siles, E.; Tucek, J. (Univ. P. J. Safarika, Kosice, Czech.). Fyz. Cas.; 21: No. 2-3, 173-176(1971). (In Czech).

Stripping in the reaction of 2.45-GeV/c deuterons in a photographic emulsion was studied; the mean free path under these conditions has been found to be 67 ± 15 cm. Secondary particles other than protons were considered. The experimental aspects of the investigation are described. It was found that the influence of stripping is negligible. (1 figure, 1 table) (RWR)

26231 FAST NEUTRON RADIATIVE CAPTURE CROSS-SECTIONS FOR SOME IMPORTANT STANDARDS FROM 30 keV TO 1.5 MeV. Hellstroem, J. (Aktiebolaget Atomenergi, Studsvik, Sweden). J. Nucl. Energy; 27: No. 2, 71-79(Feb 1973).

Neutron capture radiative cross sections for Ta, Ag, In and Au were measured between 30 keV and 1.5 MeV using time-of-flight technique. The detector used was a large liquid scintillator. Cross-sections are given in relative and absolute units. (auth)

26232 γ QUANTA IN NEUTRON CAPTURE. Bollinger, L. M. (Argonne National Lab., IL). Probl. Fiz. Elem. Chastits At. Yadra; 2: No. 4, 885-916(1972). (In Russian).

Neutron-capture γ-ray experiments include studies related to the mechanism of the (n,γ) reaction, investigations in which the (n,γ) transitions are used to study the low-energy characteristics, and many others. The neutron sources and detectors most widely used for these investigations are described. For the energy range up to 10 MeV, Ge(Li) detectors are employed; with high-intensity sources, high-resolution diffraction spectrometers are used to cover the low-energy portion of the spectrum. The Ge(Li) detectors are much more efficient than the currently used γ spectrometers. In spite of concentrated efforts, the results obtained with the (CdTe) system are discouraging, and no great improvement is expected in the performance of semiconductor detectors. The mechanism of the (n,γ) process is usually evaluated on the basis of primary transitions. The statistical behavior of the (n,γ) spectra is indicated by the random distribution of the width of high-energy radiative transitions in many nuclei, specifically in ^{196}Pt. The effect of nuclear structure on the E1 emission is reviewed; giant resonances, the distribution of partial radiation width and correlations with (d,p) cross sections and neutron widths are considered. The magnetic dipole (M1) transitions presented serious experimental difficulties because they are much weaker than the electric dipole transitions. In this connection, the giant M1 resonance in the 5 to 10 MeV range was investigated by measuring the capture in the ^{117}Sn(n,γ)^{118}Sn and ^{119}Sn(n,γ)^{120}Sn reactions. Parity studies were made by (n,γ) measurements for ^{166}Ho in order to gain information about low-energy states (Review article, 19 figures, 1 table, 33 references) (TTT)

26233 (n,α) REACTION: A NEW CHANNEL FOR STUDYING NEUTRON RESONANCES. Popov, Yu. P. (Joint Inst. for Nuclear Research, Dubna, USSR). Probl. Fiz. Elem. Chastits At. Yadra; 2: No. 4, 925-938(1972). (In Russian).

Study of the (n,α) reaction promises to yield new information about the resonance states of nuclei; but the large Coulomb barrier for α particles in intermediate and heavy nuclei decreases the reaction cross section, and thus the use of very powerful sources is necessary. The α spectra of resonances have been studied at the Neutron Physics Laboratory of the Institute on the IBR reactor since 1965, and data on the α widths of the ^{147}Sm and ^{149}Sm resonances have been obtained; this work was followed by the measurement of the α spectra of individual resonances of the ^{147}Sm(n,α) reaction. Since powerful neutron spectrometers and large α-particle detectors become available, the (n,α) reaction with resonance neutrons was investigated. A 4096-channel analyzer was used to measure the reaction cross section; the energy resolution of the ionization chamber amounted to about 200 keV for E_α = 8 to 10 MeV. The dependence of the α-particle count rate on the flight time of the neutrons and the α-particle spectra of the individual resonances of the ^{147}Sm(n,α)^{144}Nd reaction was also determined. The interaction of α particles with nuclei, as examined on the basis of the optical model, is becoming increasingly important for astrophysical research. The shift of the giant resonances may allow determination of the parity of the state of the daughter nucleus undergoing α decay. (8 figures, 2 tables) (TTT)

Nuclear Properties and Reactions, 150 ≤ A ≤ 189

Refer also to abstracts 24708, 24772, 25679, 26070, 26089, 26103, 26126, 26143, 26144, 26150, 26165, 26180, 26186, 26189, 26207, 26208, 26220–26223, 26231, 26232, 26275, 26300, 26301, 26304, 26311, 26312, 26353, 26361, 26369, 26400, 26411.

26234 (CONF-720404-(Vol. 1), pp 226-232) MEAN L FLUORESCENCE YIELDS AT Z = 63 AND 83. Wood, R. E.; Veluri, V. R.; Palms, J. M.; Rao, V. P. (Emory Univ., Atlanta). Jan 1973.

From International conference on inner shell ionization phenomena and future applications; Atlanta, Georgia, USA (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

The mean L-shell fluorescence yields are measured and L_1 subshell yields are deduced for transitions in europium-151 following isomeric gadolinium-151 electron capture decay and transitions in bismuth 214 following lead 214 electron-capture decay. (JFP)

26235 (CONF-720404-(Vol. 3), pp 1829-1831) E2/M1 ANOMALIES FROM L SUBSHELL RATIOS. Garcia-Bermudez, G.; LaCasse, W. M.; Hamilton, J. H. (Vanderbilt Univ., Nashville). Jan 1973.

From International conference on inner shell ionization phenomena and future applications; Atlanta, Georgia, USA (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

The discrepancies in E2/M1 admixtures of several low energy transitions in europium-153, terbium-154, lutetium-175, hafnium-177, rhenium-187, and berkelium-249 are discussed. (JFP)

26236 (CONF-720404-(Vol. 3), pp 1876-1886) INTERNAL CONVERSION OF THE NEAR-THRESHOLD 72-keV TRANSITION IN ^{187}Re. Campbell, J. L.; O'Brien, P. F. (Univ. of Guelph, Ont.). Jan 1973.

From International conference on inner shell ionization phenomena and future applications; Atlanta, Georgia, USA (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

The K conversion coefficient of the 72.0-keV E1 transition in ^{187}Re, which lies 0.32 keV above threshold, has been measured. This work is part of a program of studies of near-threshold transitions. No anomaly was observed, the preliminary value of α_K = 0.77, 0.04 agreeing well with conventional theory. (auth)

26237 (CONF-720404-(Vol. 3), pp 1887-1894) DETERMINATION OF THE K-CONVERSION COEFFICIENT FOR THE NEAR THRESHOLD M1 TRANSITION IN ^{164}Ho. Kaffrell, N. (Univ., Mainz); Zylicz, J. Jan 1973.

From International conference on inner shell ionization phenomena and future applications; Atlanta, Georgia, USA (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

The K-conversion coefficient of the 56.64-keV M1 (+0.14% E2), near threshold, transition in ^{164}Ho has been found to be 12.3 ± 0.5 which is close to the theoretical M1 value of 11.7. (auth)

26238 (CONF-720404-(Vol. 3), pp 2035-2049) INVESTIGATION OF L X-RAY–L X-RAY COINCIDENCES IN THE ELECTRON CAPTURE NUCLIDE ^{181}W. Konstantinov, A. A.; Sepman, S. V.; Sazonova, T. E. (Mendeleev Inst. of Metrology, Leningrad). Jan 1973.

From International conference on inner shell ionization phenomena and future applications; Atlanta, Georgia, USA (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

Investigation of L x-ray–L x-ray coincidences in the decay of ^{181}W with two 2π proportional counters shows that the number of additional double vacancies produced in the L-shell is three times larger than calculated. This is ascribed to the fact that the change in the total binding energy of all electrons of an atom in electron capture is spent on production of additional vacancies in the electron shells, starting with the L-shell, and is not carried off by the

neutrino as has been assumed previously. Similarly, the existing discrepancy between the experimental spectrum of multiply-charged recoil ions from electron capture and the calculated spectrum can be explained in this way. This explanation also eliminates the necessity for the Bahcall exchange correction in electron capture theory, which was introduced to account for the experimental observation that there is more L-capture as compared to K-capture than predicted by uncorrected electron capture theory. The large anisotropy (18%) in the angular correlation between the L x-ray–L x-ray photons does not account for the excess number of L x-ray–L x-ray coincidences over the calculated number. (auth)

26239 (COO-498-88) PROGRAM IN NUCLEAR SPECTROSCOPY. Final report. Mihelich, J. W. (Notre Dame Univ., Ind.) 30 Nov 1971. Contract AT(11-1)-498. 13p. Dep. NTIS $3.00.

This project was concerned with detailed investigations of the properties of nuclear levels, primarily in the rare earth region, beginning at a time when extremely little was known about them. Scintillation spectrometers, beta spectrometers, and high-resolution Ge(Li) and Si(Li) detectors were employed in a number of configurations to do singles and coincidence measurements and make determinations of very short nuclear level lifetimes by using radioactive sources. In recent years, the research was broadened to make use of the FN accelerator, including Coulomb excitation and other in-beam experiments. Data were obtained on energies, spins, and parities of levels; internal conversion coefficients; multipole mixing in gamma transitions; level half-lives and retardation factors, systematics, electromagnetic transition probabilities, and band mixing. (auth)

26240 (IAE-2170) INVESTIGATION OF THE ^{163}Dy PARTIAL RADIATION WIDTHS BY THE METHOD OF THE NEUTRON RESONANCES. Danelyan, L. S.; Kardon, B.; Sabo, L.; Sotnikov, S. K.; Sheresh, Z. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow. Institut Atomnoi Energii). 1971. 32p. (In Russian). INIS.

The γ spectrum in the reaction ^{163}Dy(n,γ)^{164}Dy was investigated with a Ge(Li) spectrometer. A series of phenomena of a non-statistical character was detected: correlations between the reduced partial radiative and neutron widths and between different partial radiative widths. The absolute mean reduced partial widths exceed the evaluation with respect to different models and experimental results for other nuclei. The degree of freedom of the distribution of the partial widths for transitions to the ground-state rotational and γ-vibrational bands $\nu = 2 \pm 0.5$. The observed effects can qualitatively be explained by excitation of three-quasi-particle states. (tr-auth)

26241 (JINR-P4-6825) EXCITATION OF 0^+ STATES IN TWO-NUCLEON-TRANSFER REACTIONS IN RARE-EARTH REGION NUCLEI. Abdulvagabova, S. K. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1972. 18p. (In Russian). Dep. NTIS (U. S. Sales Only).

Properties of 0^+ excited states, generated by the pairing, quadrupole, and spin–quadrupole interactions in rare earth region nuclei, are studied. The zero excitation energies for 0^+ states, probabilities of E0 and E2 transitions, and their ratios (Rasmussen parameter X) are calculated as well as the spectroscopic factors for 0^+ state excitation in the two-nucleon-transfer reactions. The calculations for all the nuclei agree satisfactorily with experimental data with the spin–quadrupole interactions taken into account. (auth) (2 figures, 1 table).

26242 PERTURBED ANGULAR CORRELATIONS IN ^{154}Gd, ^{152}Gd, AND ^{152}Sm. Vesna, V. A.; Kaminker, D. M. (Leningrad Inst. of Nuclear Physics). Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 10, 2128-2130(Oct 1972). (In Russian).

A study was made of the perturbed angular correlation in the isotopic region in which atoms are found in the ^{6}S state. Europium salts were irradiated in a reactor, and measurements were conducted at the four angles: 90, 120, 150, and 180°. Data were thus obtained on angular correlations in ^{152}Gd, ^{154}Gd, and ^{152}Sm. (2 tables) (KSW)

26243 NEW ISOTOPES ^{178,180,181}Ir. The Decay Scheme of ^{182}Ir. Akhmadzhanov, A. I.; Bayar, B.; Broda, R.; (and others) (Joint Inst. for Nuclear Research, Dubna, USSR). Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 10, 2066-2073(Oct 1972). (In Russian).

The isotopes ^{178}Ir, ^{180}Ir, and ^{181}Ir were identified, and their half-lives were measured as 0.5 ± 0.3, 1.5 ± 0.1, and 5.0 ± 0.3 min. Preparation was by the ^{169}Tm (^{16}O,xn) reaction. The decay scheme for the isotope ^{182}Ir (15 min) is presented. (4 figures, 3 tables) (KSW)

26244 INTENSITY OF K X-RAYS WHICH ACCOMPANY THE DECAY OF ^{159}Dy. Sergienko, V. A.; Safonov, L. A. (Leningrad State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 10, 2175-2178(Oct 1972). (In Russian).

The K X radiation from ^{159}Dy was investigated with a Ge(Li) detector and γ spectrometer. The isotope ^{159}Dy was produced by irradiation of Dy_2O_3 (18% ^{158}Dy) in a nuclear reactor. The probability of decay of ^{159}Dy was determined on the basis of the daughter nucleus ^{159}Tb. (2 figures, 1 table) (KSW)

26245 DECAY OF ^{173}Hf. Gnatovich, V.; Zvol'ska, V.; Zvol'ski, I.; Rzhikovska, I.; Mashtalka, A. (Inst. of Nuclear Physics, Prague). Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 10, 2131-2135 (Oct 1972). (In Russian).

The γ radiation and $\gamma-\gamma$ coincidences in the decay of ^{173}Hf were investigated. Samples of natural Yb were bombarded with α particles in a cyclotron to obtain the ^{173}Hf. The decay scheme ^{173}Hf → ^{173}Lu was constructed. Quantum characteristics of levels above 900 keV were determined and an interpretation of some of these levels was made. The states 981.8-keV, $1/2^+$ and 1,003.4-keV, $3/2^+$ proved to be levels of the bands of type [411]↓ + Q(20). (2 figures, 1 table) (KSW)

26246 EXCITED STATES OF ^{157}Dy POPULATED IN THE DECAY OF ^{157}Ho ($T_{1/2}$ = 14 MIN). Vylov, Ts.; Gromov, K. Ya.; Zelinski, A.; (and others) (Joint Inst. for Nuclear Research, Dubna, USSR). Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 10, 2111-2117(Oct 1972). (In Russian).

The spectra of γ rays, conversion electrons, and $\gamma-\gamma$ coincidences were investigated in the decay of ^{157}Ho. More than 50 transitions were detected. The decay scheme was constructed for the decay ^{157}Ho → ^{157}Dy. (2 figures, 5 tables) (tr-auth)

26247 γ-RADIATION OF ^{169}Yb IN THE REGION E_γ > 300 keV. Balalaev, V. A.; Dzhelepov, B. S. (All-Union Scientific-Research Inst. of Metrology, Leningrad). Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 10, 2089-2096(Oct 1972). (In Russian).

This paper is an extension of earlier work by the authors (1970) on the γ spectrum of ^{169}Yb and the eight γ transitions with energies $h\nu > 300$ keV, and describes the search for new weak γ transitions in the region $h\nu > 300$ keV. Samples of enriched ^{168}Yb were irradiated with thermal neutrons in a nuclear reactor for ~ one month. In the region $E_\gamma > 773$ keV, γ rays were not observed with an intensity > 0.05. The decay scheme for ^{169}Yb was constructed, upper limits of the intensities of γ rays were established, and internal conversion coefficients and multipole orders for transitions with $E_\gamma > 307$ keV were tabulated. (2 figures, 3 tables) (KSW)

26248 STRUCTURE OF ISOMERIC STATES OF ^{148,150,152}Tb AND THE TWO-PARTICLE LEVELS OF ^{148,150,152}Gd and ^{146,148}Sm. Arl't, R.; Kuznetsov, V. V.; Nolbert, V.; (and others) (Joint Inst. for Nuclear Research, Dubna, USSR). Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 10, 2074-2079(Oct 1972). (In Russian).

The energy-level diagrams were constructed for ^{148}Gd (excited during the decay of ^{148}Tb, and compared with the energy-level schemes for ^{144}Nd and ^{146}Sm) and ^{150}Gd (excited during the decay of ^{150}Tb*, and compared with the levels for ^{148}Sm). The decay schemes are presented for ^{152}Tb* → ^{152}Gd and ^{154}Ho → ^{154}Dy. (4 figures, 2 tables) (KSW)

26249 POSSIBLE REGION OF SINGULARITY IN GROUND-STATE ROTATIONAL BANDS OF DEFORMED NUCLEI. Birbrair, B. L. (Leningrad Inst. for Nuclear Physics). Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 10, 2193-2195(Oct 1972). (In Russian).

Singularities in ground-state rotational bands of deformed nuclei of the type observed in Dy and Er isotopes were observed as an effect of the first critical rotational frequency. The latter is analogous to the well-known Meissner effect in superconductors. With this as a basis, the possibility of observing analogous singularities in other nuclei was predicted. (1 table) (tr-auth)

26250 ANALYSIS OF SCATTERING OF POLARIZED PROTONS BY THE NUCLEI ^{148}Sm AND ^{152}Sm. Kurepin, A. B.; Lombard, R. M. (Inst. of Nuclear Research, Moscow). Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 10, 2232-2235(Oct 1972). (In Russian).

Measurements of elastic and inelastic scattering of 24.5-MeV polarized protons by ^{148}Sm and deformed ^{152}Sm were conducted for purposes of comparison. Scattering was recorded by a system of cooled Si(Li) detectors in the angular interval from 35 to 155°. A comparison of the data from the two Sm isotopes showed that a qualitative difference existed in the angular dependence of the asymmetry for inelastic scattering of protons from the lowest excited 2^+ levels. (2 figures, 2 tables) (KSW)

26251 STUDY OF THE GROUND STATE ROTATIONAL BANDS OF ^{168}Yb, ^{170}Yb, AND ^{172}Yb BY (HEAVY ION,xn) REACTIONS. Mo, J. N.; Chapman, R.; Dracoulis, G. D.; Gelletly, W.;

Hartley, A. J. (Univ. of Manchester, Eng.). J. Phys. (Paris), Colloq.; No. 5, 101(1972).

The ground-state rotational bands of ^{168}Yb, ^{170}Yb, and ^{172}Yb were studied by in-beam measurements of gamma rays following the reactions ^{166}Er(α,2n)^{168}Yb, ^{170}Er(α,2n)^{172}Yb, ^{170}Er(α,4n)^{170}Yb, and ^{160}Gd(^{12}C,4n)^{168}Yb. (FR)

26252 NUCLEAR LEVELS OF ^{183}Ir, ^{177}Lu, ^{171}Tm, AND ^{159}Tb. Begzhanov, R. B.; Kobilov, O. Sh.; Radzhapov, P. S.; Sabirov, Kh. S. (Inst. of Nuclear Physics, Tashkent). Izv. Akad. Nauk Uzb. SSR, Ser. Fiz.-Mat. Nauk; No. 4, 48-54(1972). (In Russian).

Gamma–gamma coincidences were investigated in the decay of the nucleus ^{177}Yb, and angular correlations of cascade γ radiation, in the nuclei ^{183}Ir, ^{177}Lu, ^{171}Tm, and ^{159}Tb. Lifetimes of some levels were measured for the nucleus ^{183}Ir. Energies and relative intensities of γ rays were determined for ^{177}Yb, and a decay scheme was constructed. The angular moments of the majority of the levels investigated were obtained from the multipole structure of the γ transitions. (1 figure) (tr-auth)

26253 DE-EXCITATION OF COMPOUND NUCLEI FORMED IN ^{181}Ta + ^{10}B OR ^{11}B INTERACTIONS. Delagrange, H.; Hubert, F.; Fleury, A. (Univ., Bordeaux). J. Phys. (Paris), Colloq.; No. 5, 100(1972). (In French).

Studies of ^{181}Ta + ^{11}B or ^{10}B interactions enabled the essential parameters occurring in the de-excitation of the compound nucleus by the emission of neutrons, protons, α particles, and quadrupole or dipole γ rays to be analyzed. (FR)

26254 NEW OSMIUM ISOTOPES: ^{170}Os AND ^{171}Os. Toth, K. S.; Hahn, R. L. (Oak Ridge National Lab., TN). J. Phys. (Paris), Colloq.; No. 5, 93(1972).

Two new α emitters were observed by bombarding ^{156}Dy with ^{20}Ne ions (from 151.7 to 100.8 MeV). Evidence is given that these α emitters are the ^{170}Os and ^{171}Os isotopes. (FR)

26255 RADIOACTIVITY IN NUCLEAR SPECTROSCOPY. Modern Techniques and Applications. Volume II. Hamilton, J. H.; Manthuruthil, J. C. (eds.). New York; Gordon and Breach, Science Publishers, Inc. (1972). 929p. (CONF-690818-Vol.2)).

From International Conference on Radioactivity in Nuclear Spectroscopy; Nashville, Tennessee, United States of America (USA). (11 Aug 1969).

This volume contains invited papers on the following topics: techniques in electron and gamma-ray spectroscopy (8 papers), internal conversion processes (9 papers), directional correlations and measurements of M1–E2 mixing ratios (4 papers), hyperfine fields (4 papers), and a concluding session including a paper on photoelectron spectroscopy. Forty-nine contributed papers also appear in this volume. (RWR)

For abstracts of individual papers see: 24640–24644, 24714–24723, 25630, 26173, 26208–26217, 26256–26274, 26300–26309, 26355–26359, 26400–26406.

26256 APPLICATIONS OF QUANTITATIVE GAMMA–GAMMA COINCIDENCE MEASUREMENTS. Johnson, N. R. (Oak Ridge National Lab., TN). pp 675-684 of Radioactivity in Nuclear Spectroscopy. Vol. II. Hamilton, J. H. (Ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From International Conference on Radioactivity in Nuclear Spectroscopy; Nashville, Tennessee, United States of America (USA) (11 Aug 1969). See CONF-690818-(Vol. 2).

The use of the gamma–gamma coincidence method for delineation of the features of a complicated nuclear level scheme is discussed, along with the interpretation of the data obtained. Some of the problems encountered in coincidence measurements are indicated. (6 figures, 1 table) (RWR)

26257 INTERNAL CONVERSION ELECTRON PARTICLE PARAMETERS OF THE 111 keV TRANSITION IN ^{184}W. Doubt, H. A.; (Univ. of Sussex, Brighton, Eng.); Hamilton, W. D.; Davies, K. E.; Grabowski, Z. W. pp 887-895 of Radioactivity in Nuclear Spectroscopy. Vol. II. Hamilton, J. H. (Ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From International Conference on Radioactivity in Nuclear Spectroscopy; Nashville, Tennessee, United States of America (USA) (11 Aug 1969). See CONF 690818-(Vol. 2).

Gamma spectra and γ–γ angular correlations were measured for a ^{184}Re source; e–γ correlations were also measured. Experimental and theoretical particle parameters for the 111-keV transition are tabulated. (2 figures, 2 tables) (RWR)

26258 DIRECTIONAL CORRELATION TECHNIQUES WITH NaI SYSTEMS AND MEASUREMENTS OF M1/E2 MIXING RATIOS FROM GAMMA BANDS IN DEFORMED NUCLEI. Bodenstedt, E. (Univ., Bonn). pp 905-934 of Radioactivity in Nuclear Spectroscopy. Vol. II. Hamilton, J. H. (Ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From International Conference on Radioactivity in Nuclear Spectroscopy; Nashville, Tennessee, United States of America (USA) (11 Aug 1969). See CONF-690818-(Vol. 2).

The theoretical basis of the angular correlation technique is discussed first, and the procedure for obtaining absolute values for the angular correlation coefficients of the interesting transition is explained. Several specific nuclei are then considered. The angular correlation function for the decay of ^{160}Tb is found. Experiments for determining the mixing ratio for transitions in ^{152}Sm, ^{154}Gd, ^{160}Dy, ^{168}Er, and ^{186}Os are described. (23 figures, 2 tables) (RWR)

26259 GAMMA–GAMMA DIRECTIONAL CORRELATION STUDIES WITH Ge(Li) DETECTORS AND MEASUREMENTS OF E2/M1 MIXING RATIOS IN TRANSITIONS FROM BETA VIBRATIONAL BANDS. Hamilton, J. H. (Vanderbilt Univ., Nashville). pp 935-1006 of Radioactivity in Nuclear Spectroscopy. Vol. II. Hamilton, J. H. (Ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From International Conference on Radioactivity in Nuclear Spectroscopy; Nashville, Tennessee, United States of America (USA) (11 Aug 1969). See CONF-690818-(Vol. 2).

The different types of systems that use one or two Ge(Li) detectors with variations in the choice of energy gates and multichannel analysis in one or both channels for γ–$\gamma(\theta)$ studies are described in detail. Some of the problems associated with the merits of each system for different types of radioactive decays are discussed. The choice of system, in general, depends on the type measurements planned. NaI(Tl)–Ge(Li) systems for γ–$\gamma(\theta)$ studies are considered first; the following variations are described: systems with energy gates on both detectors; systems with NaI multichannel analysis and Ge(Li) energy gate; systems with NaI energy gate and Ge(Li) multichannel analysis; and NaI–Ge(Li) systems with multichannel analysis in both. The Ge(Li)–Ge(Li) systems for γ–$\gamma(\theta)$ measurements are taken up. The following variations are examined: energy gate selection in both detectors; gate selection and spectrum analysis in the two channels; and spectrum analysis in both channels. In the last part the author's results on M1–E2 mixing in $\Delta I = 0$ transitions between $K = 0$ bands in deformed nuclei are presented; these include correlations with the 123-keV, $2^+ \rightarrow 0^+$ transition in ^{154}Gd, correlations with the 248-keV, $4^+ \rightarrow 2^+$ transition, conclusions for ^{152}Sm and ^{154}Gd, and ^{178}Hf measurements. (33 figures, 8 tables, 70 references) (RWR)

26260 COULOMB EXCITATION STUDIES OF E2 MATRIX ELEMENTS, Me–E2 MIXING, AND BAND MIXING IN TRANSITION NUCLEI. Greenberg, J. S. (Yale Univ., New Haven). pp 1007-1037 of Radioactivity in Nuclear Spectroscopy. Vol. II. Hamilton, J. H. (Ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From International Conference on Radioactivity in Nuclear Spectroscopy; Nashville, Tennessee, United States of America (USA) (11 Aug 1969). See CONF-690818-(Vol. 2).

Results obtained from multiple Coulomb excitation studies of two related aspects of a currently interesting problem associated with the nonadiabatic effects of nuclear rotations on the properties of low-lying states in deformed nuclei are discussed. One of these concerns a further examination of the scope and source of the inconsistency in the determination of band mixing in transition nuclei. Immediately related to the examination of this inconsistency is a search for M1 admixtures in the $I \rightarrow I$ transitions from β-band to ground-state-band states. As the other aspect of the question of nonadiabatic effects of rotations, studies to measure the departure from the constant intrinsic quadrupole moment for ground-state-band states predicted by the adiabatic rotational model are discussed. The departures may be related in part to couplings between rotational and intrinsic motion; and, therefore, together with the investigations of the vibrational bands, they provide a method to investigate these couplings. The measurements discussed deal principally with ^{152}Sm and ^{154}Sm, although some results are also presented for ^{150}Nd. (14 figures, 1 table) (RWR)

26261 COULOMB EXCITATION OF ^{152}Sm, ^{166,168,170}Er, AND ^{232}Th. McGowan, F. K. (Oak Ridge National Lab., TN). pp 1039-1050 of Radioactivity in Nuclear Spectroscopy. Vol. II. Hamilton, J. H. (Ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From International Conference on Radioactivity in Nuclear Spectroscopy; Nashville, Tennessee, United States of America (USA) (11 Aug 1969). See CONF-690818-(Vol. 2).

Gamma spectra are shown for 13.0-MeV α particles on ^{152}Sm and 5.0-MeV protons on ^{232}Th. B(E2) values and mixing ratios are tabulated for the higher $2'^+$ states of the nuclei studied. B(E2) ratios and Z_K values extracted on the assumption of a coupling between vibration and rotation are summarized. (2 figures, 2 tables) (RWR)

26262 REVIEW OF PAC HYPERFINE STUDIES WITH IMPLANTED SOURCES. Deutch, B. I.; Nielsen, K. B. (Univ. of Aarhus, Denmark). pp 1087-1117 of Radioactivity in Nuclear Spectroscopy. Vol. II. Hamilton, J. H. (Ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From International Conference on Radioactivity in Nuclear Spectroscopy; Nashville, Tennessee, United States of America (USA) (11 Aug 1969). See CONF-690818-(Vol. 2).

Some of the latest developments concerning integral perturbed angular correlation (PAC) measurements with implanted atoms in various substrates, both ferromagnetic and nonferromagnetic, are reviewed. Special emphasis is placed on the use of isotope separator-implanted radioactive sources. Among the topics considered are the limitations of the method, relaxation processes, experiments with charged-particle cascades, and the effective internal magnetic fields of nuclei in ferromagnetic backing. (10 figures) (RWR)

26263 ORBITAL ELECTRON CAPTURE DECAY OF ^{159}Dy. Wood, R. E.; Palms, J. M.; Rao, P. V. (Emory Univ., Atlanta). pp 1231-1235 of Radioactivity in Nuclear Spectroscopy. Vol. II. Hamilton, J. H. (Ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From International Conference on Radioactivity in Nuclear Spectroscopy; Nashville, Tennessee, United States of America (USA) (11 Aug 1969). See CONF-690818-(Vol. 2).

26264 COINCIDENCE STUDIES OF THE ^{171}Er DECAY. Geiger, J. S.; Graham, R. L. (Atomic Energy of Canada Ltd., Chalk River, Ont.). pp 1237-1240 of Radioactivity in Nuclear Spectroscopy. Vol. II. Hamilton, J. H. (Ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From International Conference on Radioactivity in Nuclear Spectroscopy; Nashville, Tennessee, United States of America (USA) (11 Aug 1969). See CONF-690818-(Vol. 2).

26265 ISOMER IN ^{174}Hf. Ejiri, H.; Ferguson, S. M.; Heffner, R. H.; Wieman, H. (Univ. of Washington, Seattle). pp 1241-1248 of Radioactivity in Nuclear Spectroscopy. Hamilton, J. H. (Ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From International Conference on Radioactivity in Nuclear Spectroscopy; Nashville, Tennessee, United States of America (USA) (11 Aug 1969). See CONF-690818-(Vol. 2).

26266 GAMMA RAYS FROM THE DECAY OF ^{174}Ta TO ^{174}Hf. Gillin, M. T.; Peek, H. F. (Univ. of California, Davis). pp 1249-1251 of Radioactivity in Nuclear Spectroscopy. Vol. II. Hamilton, J. H. (Ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From International Conference on Radioactivity in Nuclear Spectroscopy; Nashville, Tennessee, United States of America (USA) (11 Aug 1969). See CONF-690818-(Vol. 2).

26267 L-SUBSHELL CONVERSION LINE INTENSITY RATIOS FOR THE 82.45 keV PURE M1 TRANSITION IN ^{166}Ho. Manthuruthil, J. C. (Aerospace Research Labs., Wright Patterson Air Force Base, Ohio); Hennecke, H. J.; Pinajian, J. J. pp 1357-1361 of Radioactivity in Nuclear Spectroscopy. Vol. II. Hamilton, J. H. (Ed.). New York; Gordon and Breach Publishers, Inc. (1972).

From International Conference on Radioactivity in Nuclear Spectroscopy; Nashville, Tennessee, United States of America (USA) (11 Aug 1969). See CONF-690818-(Vol. 2).

26268 MEASUREMENT OF K CONVERSION COEFFICIENTS IN ^{170}Yb AND ^{166}Er WITH A Ge(Li) X-RAY DETECTOR. Campbell, J. L.; Goble, R. J.; Smith, H. J. (Univ. of Guelph, Ont.). pp 1387-1393 of Radioactivity in Nuclear Spectroscopy. Vol. II. Hamilton, J. H. (Ed.). New York; Gordon and Breach Publishers, Inc. (1972).

From International Conference on Radioactivity in Nuclear Spectroscopy; Nashville, Tennessee, United States of America (USA) (11 Aug 1969). See CONF-690818-(Vol. 2).

26269 K CONVERSION COEFFICIENTS OF THE 84.3 keV TRANSITION IN ^{170}Yb AND THE 66.7 keV TRANSITION IN ^{171}Yb. Rao, P. V. (Emory Univ., Atlanta); Mohan, S.; Freund, H. U.; Fink, R. W. pp 1395-1399 of Radioactivity in Nuclear Spectroscopy. Vol. II. Hamilton, J. H. (Ed.). New York; Gordon and Breach Publishers, Inc. (1972).

From International Conference on Radioactivity in Nuclear Spectroscopy; Nashville, Tennessee, United States of America (USA) (11 Aug 1969). See CONF-690818-(Vol. 2).

26270 INTERNAL CONVERSION OF THE 208 AND 113 keV TRANSITIONS IN ^{177}Hf. Holmberg, L.; Stefansson, V.; Gunnerhed, M. (Univ. of Stockholm). pp 1407-1410 of Radioactivity in Nuclear Spectroscopy. Vol. II. Hamilton, J. H. (Ed.). New York; Gordon and Breach Publishers, Inc. (1972).

From International Conference on Radioactivity in Nuclear Spectroscopy; Nashville, Tennessee, United States of America (USA) (11 Aug 1969). See CONF-690818-(Vol. 2).

26271 SEARCH FOR VACUUM EFFECTS ON THE 1274–123-keV, $\gamma-\gamma$ DIRECTIONAL CORRELATION IN ^{154}Gd. Croft, W. L.; Krmpotic, D.; Hamilton, J. H. (Vanderbilt Univ., Nashville). pp 1445-1446 of Radioactivity in Nuclear Spectroscopy. Vol. II. Hamilton, J. H. (Ed.). New York; Gordon and Breach Publishers, Inc. (1972).

From International Conference on Radioactivity in Nuclear Spectroscopy; Nashville, Tennessee, United States of America (USA) (11 Aug 1969). See CONF-690818-(Vol. 2).

26272 PERTURBED ANGULAR CORRELATIONS OF GAMMA RAYS FROM ^{172}Yb IN SOLIDS. Rasera, R. L.; Li-Scholz, A. (Univ. of Pennsylvania, Philadelphia). pp 1461-1467 of Radioactivity in Nuclear Spectroscopy. Vol. II. Hamilton, J. H. (Ed.). New York; Gordon and Breach Publishers, Inc. (1972).

From International Conference on Radioactivity in Nuclear Spectroscopy; Nashville, Tennessee, United States of America (USA) (11 Aug 1969). See CONF-690818-(Vol. 2).

26273 INVESTIGATION OF THE ELECTRIC FIELD GRADIENT AT THE NUCLEAR SITE AND THE DETERMINATION OF THE QUADRUPOLE MOMENT OF THE NUCLEUS OF ESCA METHOD. Sen, S. K.; Gupta, R. P. (Univ. of Manitoba, Winnipeg). pp 1469–1474 of Radioactivity in Nuclear Spectroscopy. Vol. II. Hamilton, J. H. (Ed.). New York; Gordon and Breach Publishers, Inc. (1972).

From International Conference on Radioactivity in Nuclear Spectroscopy; Nashville, Tennessee, United States of America (USA) (11 Aug 1969). See CONF-690818-(Vol. 2).

26274 HYPERFINE STUDIES OF ^{169}Yb, ^{175}Yb, AND ^{238}Np IMPLANTED IN IRON. Raven, H.; Abildskov, F.; Johansen, H. K.; Deutch, B. I. (Univ. of Aarhus, Denmark). pp 1481-1490 of Radioactivity in Nuclear Spectroscopy. Vol. II. Hamilton, J. H. (Ed.). New York; Gordon and Breach Publishers, Inc. (1972).

From International Conference on Radioactivity in Nuclear Spectroscopy; Nashville, Tennessee, United States of America (USA) (11 Aug 1969). See CONF 690818-(Vol. 2).

26275 CHANGE OF NUCLEAR RADII DUE TO ROTATION: CALCULATION OF MOESSBAUER AND MUONIC ISOMER SHIFTS. Meyer, J. (Technische Univ., Garching, Ger.); Speth, J. Nucl. Phys.; A203: No. 1, 17-41(1973).

Moessbauer and muonic isomer shifts of 2^+ rotational states are calculated for rare earth nuclei in good agreement with experiment by using Migdal's effective p–h and p–p interactions. The second-order cranking equations are developed in the framework of the theory of finite Fermi systems. In contrast to the pairing-plus-quadrupole model, the results of this work show a small stretching contribution for most nuclei, but a dominating role for the Coriolis antipairing effect. Shrinking charge radii are found for Dy and Os isotopes and some other nuclei as a consequence of the CAP mechanism. Detailed information is given about the redistribution of protons and neutrons due to rotation. It is seen that only a few levels within the range of the diffuse Fermi edge take part in the redistribution and determine the isomer shifts. Shrinking m.s. proton radii and, at the same time, increasing m.s. neutron radii are obtained for the "back-bending" nuclei ^{158,160,162}Dy, ^{160,162}Er and ^{164,166}Yb. (4 figures, 3 tables) (auth)

26276 DECAY OF ^{176}Ta TO LEVELS IN ^{176}Hf. Bernthal, F. M.; Rasmussen, J. O.; Hollander, J. M. (Univ. of California, Berkeley). pp 337-350 of Radioactivity in Nuclear Spectroscopy. Vol. I. Hamilton, J. H. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From International Conference on Radioactivity in Nuclear Spectroscopy; Nashville, Tennessee, United States of America (USA) (11 Aug 1969). See CONF-690818-(Vol.1).

A detailed experimental study of the decay of ^{176}Ta to levels in ^{176}Hf is described, with emphasis on the instrumentation and analysis techniques used to unravel this extremely complicated decay. Numerous semiconductor detection systems were employed in conjunction with an on-line PDP-7 data acquisition system to gather Compton-suppressed γ-ray singles, conversion-electron, and $\gamma-\gamma$ coincidence data for over 300 lines observed from 0 to 3 MeV in the ^{176}Ta spectrum. Some 140 of the transitions received definite assignments in the proposed ^{176}Hf level scheme and, by using com-

puter techniques, an additional 80 transitions can be assigned on the basis of energy sums and differences. Of the 48 excited levels in ^{176}Hf deduced from the decay data, 17, including two low-lying K = 0+ states at 1150 and 1293 keV, received definite spin and parity assignments. Tentative characterizations are proposed for an additional 20 levels. The singles data and over 70 $\gamma-\gamma$ coincidence spectra were all analyzed on-line to the LRL CDC-6600 computer with use of the computer code SAMPO. The method and reliability of the analysis are briefly discussed. (6 figures, 2 tables) (auth)

26277 ^{16}O INDUCED TRANSFER REACTIONS ON RARE EARTHS NEAR THE COULOMB BARRIER. Cassagnou, Y.; Lamehi-Rachti, M.; Levi, C.; Mittig, W.; Papineau, L. (CEN de Saclay, Gif-sur-Yvette, France). J. Phys. (Paris), Colloq.; No. 5, 79(1972). (In French).

Transfer reactions induced by 68-MeV ^{16}O ions on ^{144}Sm, ^{152}Sm, ^{170}Yb, ^{174}Yb, ^{176}Yb and ^{171}Yb at backward angles were studied; 2p and α transfers are of the same order of magnitude. (FR)

26278 PARITY VIOLATION IN NUCLEI SHORT RANGE CORRELATIONS. Vinh Mau, N. (Inst. of Nuclear Physics, Orsay, France). pp 99-111 of Symposium on Nucleons and Weak Interactions. Eman, B. (ed.). Zagreb; Institute Rudjer Boskovic (1971).

From Symposium on nucleons and weak interactions; Zagreb, Yugoslavia (Jul 1971). See CONF-710737-.

The theoretical results on the circular polarization of gamma rays emitted by nonpolarized nuclei are reviewed. The 482-keV transition in tantalum-181, the 396-keV transition in lutetium-175, and the 1290-keV transition in potassium-41 are discussed. (JFP)

26279 IMPROVED EXPERIMENT ON PARITY MIXING IN ^{180}Hf. Jenschke, B. (Univ., Karlsruhe, Ger.). pp 293-298 of Symposium on Nucleons and Weak Interactions. Eman, B. (ed.). Zagreb; Institute Rudjer Boskovic (1971).

From Symposium on nucleons and weak interactions; Zagreb, Yugoslavia (Jul 1971). See CONF-710737-.

The circular polarization of the 501-keV gamma transition in hafnium-180 was measured and found to be $P = -(28 \pm 2)\ (10)^{-4}$ with 20% systematic error. (JFP)

26280 E0 TRANSITIONS IN ATOMIC NUCLEI. Aldushchenkov, A. V.; Voinova, N. A. (Inst. of Nuclear Physics, Leningrad). Nucl. Data, Sect. A; 11: No. 4, 299-325(1973).

Experimental data on E0 transitions in atomic nuclei are collected. Consideration is given to the levels with both zero and nonzero spins. The experimental values of the E0 strength parameter, $\rho(E0)$, and of the ratio, X(E0/E2), of E0 to E2 transition probabilities are compared with the results of calculations by means of the phenomenological models of Davydov and Bohr–Mottelson. The data for the transitions between 2^+ levels are also compared with the results of semimicroscopic calculations by Kumar and Baranger. For $0^+ \rightarrow 0^+$ transitions a comparison is made with the microscopic model of Kuliev and Pyatov. (1 figure, 5 tables) (auth)

26281 ISOMERISM IN ^{154}Pm. Preiss, I. L.; Labrecque, J. J. (Rensselaer Polytechnic Inst., Troy, NY). J. Inorg. Nucl. Chem.; 35: No. 4, 1057-1062(Apr 1973).

A study of the decay of the isomers of ^{154}Pm to levels of ^{154}Sm has been performed using enriched ^{154}Sm oxide targets and (n,p) reactions at 14.8 MeV. It is shown that the dominant gamma transition at 0.185 MeV has half-lives of 1.6 min ± 0.2 and 2.5 min ± 0.3. The separation energy of the two isomers is less than or equal to 200 keV with $E_{\beta max}$ of 4.03 MeV. The gamma rays associated with the 1.6 min half-life are 0.082, 0.185, 1.36, 1.44, 2.05 and 2.14 MeV, while the gamma rays with the 2.5 min half-life are 0.082, 0.185, 0.282, 0.743, 0.930, 1.36 and 1.44 MeV. Spins of 1+ and 4+ are deduced from the Nilsson orbitals, and it is shown that there is no highly converted isomeric transition. (auth)

26282 MULTIPOLE MIXING RATIOS OF ELECTROMAGNETIC TRANSITIONS IN ^{152}Sm. Kalfas, C. A.; Hamilton, W. D.; Doubt, H. A. (Sussex Univ., Brighton, Eng.). J. Phys., A (London); 6: No. 2, 247-264(Feb 1973).

By using $\gamma\gamma(\theta)$ and $e_{K\gamma}(\theta)$ directional correlation techniques, the following were determined: (a) the multipole character of some transitions connecting the quadrupole and octupole vibrational bands to the ground-state rotational band in ^{152}Sm following the decay of ^{152}Eu; and (b) the K-shell particle parameter of the 121.8 keV transition which de-excites the lowest energy level of the same nucleus. The results show that transitions from the β and γ vibrational bands are predominantly E2, with a large E0 admixture in the former case, while such a contribution is almost absent in the transition from the γ band. These results are compared with Kumar's theoretical predictions and with previously reported experimental values. The investigation on the 121.8 keV K-shell particle parameter yields a value which is smaller than theoretically predicted by (8.5 ± 2.1)%. (auth)

26283 STUDY OF POSITIVE-PARITY LEVELS OF ^{165}Er WITH SPIN $\frac{1}{2}$, $\frac{3}{2}$, AND $\frac{5}{2}$. Marguier, G.; Chery, R. (Univ., Lyon). J. Phys. (Paris); 33: No. 11, 941-945(Nov 1972). (In French).

A new positive-parity level scheme for ^{165}Er excited in the decay of ^{165}Tm is presented. The $\frac{1}{2}$-, $\frac{3}{2}$-, and $\frac{5}{2}$-spin levels are interpreted in terms of classical deformed-nucleus models with Coriolis coupling and $\Delta N = 2$ coupled Nilsson orbitals. (FR)

26284 PROTON STATES IN ^{155}Tb, ^{157}Tb, ^{159}Tb, AND ^{161}Tb. Tippett, J. C.; Burke, D. G. (McMaster Univ., Hamilton, Ont.). Can. J. Phys.; 50: No. 24, 3152-3171(15 Dec 1972).

Proton states in the odd terbium isotopes ^{155}Tb, ^{157}Tb, ^{159}Tb, and ^{161}Tb were studied using (^{3}He,d) and (α,t) reactions. The beams of 24 MeV ^{3}He and 25 MeV alpha particles were produced by the McMaster University model FN tandem Van de Graaff accelerator. The reaction products were analyzed with an Enge split-pole magnetic spectrograph and detected with photographic emulsions. The ratios of cross sections in the (^{3}He,d) and (α,t) reactions were used as an indication of the l values for the proton transfers, and the spectroscopic factors were extracted using DWBA calculations. The results of the present work confirm the assignments of the $\frac{3}{2}^+[411]$ and $\frac{5}{2}^+[413]$ Nilsson orbitals in all four isotopes. The I = $1\frac{1}{2}$ states of the $\frac{5}{2}^-[532]$ and $\frac{7}{2}^-[523]$ orbitals were identified in ^{161}Tb and ^{159}Tb and their assignments confirmed in ^{157}Tb and ^{155}Tb. It was necessary to invoke appreciable Coriolis mixing between these two orbitals in order to describe the observed rotational level spacings and the spectroscopic strengths. The assignments of the $\frac{7}{2}^+[404]$ orbital were confirmed in ^{155}Tb and ^{157}Tb, and this orbital was identified in ^{159}Tb and ^{161}Tb. Previous assignments of the $\frac{1}{2}^+[411]$ particle state with vibrational admixtures were confirmed in ^{157}Tb and ^{159}Tb, and the state was identified in ^{161}Tb. The present results support earlier evidence for the existence of a second fragment of the $\frac{1}{2}^+[411]$ orbital in ^{159}Tb and suggest the presence of a similar state in ^{157}Tb. In each of the isotopes the $\frac{5}{2}^+[402]$ orbital was assigned, and a tentative assignment for the $\frac{1}{2}^-[541]$ orbital was proposed. (auth)

26285 INTERNAL CONVERSION AND RADIATIVE PROCESSES OF THE 113 keV M1–E2 TRANSITION IN ^{177}Hf. Holmberg, L.; Stefanson, V.; Becker, J.; Bargholtz, C.; Gidefeldt, L. (Univ., Stockholm). Phys. Scr.; 6: No. 4, 177-180(1972).

Gamma–electron and gamma–gamma correlations of the 208–113 keV cascade in ^{177}Hf are measured. The following ratios between directional distribution coefficients are obtained, $A_2(K)/A_2(\gamma) = -0.211 \pm 0.035$, $A_2(L)/A_2(\gamma) = 0.111 \pm 0.037$. By use of a commonly adopted value for the gamma–gamma directional correlation and the internal conversion data, the penetration contribution to the M1 component is evaluated, $\lambda = -0.6 \pm 2.0$. This is in agreement with a theoretical prediction by Reiner, $\lambda \approx -2$. The lifetime of the 113-keV state is determined, $T_{\frac{1}{2}} = 0.490 \pm 0.015$ ns. When this value is used for evaluation of the gyromagnetic ratios g_K and g_R from a PAC measurement, agreement with theoretical predictions is found. (auth)

26286 HALF-LIVES OF THE FIRST EXCITED STATES OF THE ^{155}Dy NUCLEUS: COMPARISONS WITH ^{153}Gd. Kilcher, P.; Torres, J. P.; Paris, P.; Lecouturier, D. (Paris Univ., Orsay, France). Compt. Rend., Ser., B; 275: No. 23, 877-880(6 Dec 1972). (In French).

The half-lives of the 39.4-keV ($T_{\frac{1}{2}} = 3.5 \pm 0.3$ ns) and the 86.8-keV ($T_{\frac{1}{2}} = 1.1 \pm 0.2$ ns) levels of ^{155}Dy were measured. The limiting values of the half-lives of the following levels were determined: 136.3, 202.4 and 240.3 keV. The results are compared to those obtained for the ^{153}Gd levels. A half-life was measured for the ^{157}Dy and the ^{159}Dy isotopes. (FR)

26287 ANGULAR CORRELATIONS IN ^{177}Hf. Rao, V. V. (Indian Inst. of Tech., Kharagpur); Parthasaradhi, K.; Lakshminarayana, V. Curr. Sci. (India); 42: No. 4, 123(20 Feb 1973).

The sum–coincidence spectra with a gate at 321 keV were recorded, and a correlation coefficient of $A_2 = 0.12 \pm 0.01$ was obtained. The gamma-ray spectrum in coincidence with the K x ray of ^{177}Hf was used to estimate the K-conversion coefficient of the 113-keV transition as 0.95 ± 0.02. The quadrupole contents of the 113- and 208-keV transitions were found to be (87 ± 1) and (7 ± 2)%, respectively. (RWR)

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Refer also to abstracts 24708, 24772, 25679, 26070, 26089, 26103, 26126, 26143, 26144, 26150, 26154, 26156, 26184, 26186, 26189,

26202, 26212, 26220, 26222, 26223, 26229, 26231, 26234, 26252, 26255, 26280, 26325, 26328, 26331, and 26400.

26288 (CONF-720404-(Vol. 1), pp 244-250) $L_{2,3}$ SUBSHELL FLUORESCENCE YIELDS FOR Z = 76, 78 FROM THE DECAY OF ^{192}Ir. Mohan, S.; Schmidt-Ott, W. D.; McGeorge, J. C.; Fink, R. W. (Georgia Inst. of Tech., Atlanta). Jan 1973.

From International conference on inner shell ionization phenomena and future applications; Atlanta, Georgia, USA (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

The L_2, L_3 subshell fluorescence and Coster–Kronig yields were measured for Z = 76, 78 from the electron capture and β decay branch respectively of the 74 day decay of ^{192}Ir(Z = 77). L-x ray–K-x ray coincidences were made using high resolution semi-conductor detectors. The results are given. The results for Z = 78 agree with a former measurement of L_2, L_3 subshell fluorescent yields for the same Z from the decay of ^{195}Au. Both results correspond to recent theoretical estimates. (auth)

26289 (CONF-720404-(Vol. 1), pp 251-256) L-SHELL FLUORESCENCE YIELDS OF DOUBLE VACANCY STATES IN Pb. Veluri, V. R.; Wood, R. E.; Palms, J. M.; Rao, V. P. (Emory Univ., Atlanta). Jan 1973.

From International conference on inner shell ionization phenomena and future applications; Atlanta, Georgia, USA (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

The average L fluorescence yield for the double L vacancy states for vacancies in lead following electron capture decay of bismuth-207 was found to be 0.45 ± 0.04. The average L fluorescence yield for states containing one L shell vacancy and one outer shell vacancy was found to be 0.34 ± 0.04. (JFP)

26290 (COO-1716-14) THERMODYNAMIC STUDIES ON HEAVY ELEMENTS AND STUDIES IN NUCLEAR CHEMISTRY. Annual Report for the Period February 1972–January 1973. Cobble, J. W. (ed.). (Purdue Univ., Lafayette, Ind. Dept. of Chemistry). Jan 1973. Contract AT(11-1)-1716. 21p. Dep. NTIS.

Research has been completed on the ternary fission of ^{239}Pu induced by medium-energy helium ions. Work continues on a number of heavy-ion ternary fission studies using ^{12}C and ^{20}Ne ions on gold and uranium. Feasibility studies were made on producing neutron-deficient americium isotopes from heavy-ion bombardments and studying their decay schemes, particularly spontaneous fission. The thermodynamic functions of Eu^{+2} were determined calorimetrically, and a better value of the Eu^{+2}/Eu^{+3} couple was obtained. (5 figures, 2 tables) (RWR)

26291 (NP-19693) NOTE ON THE DECAY OF ^{200}Au. Helppi, H.; Pakkanen, A. (Jyvaskyla Univ. (Finland). Dept. of Physics). Jul 1972. 10p. Dep. NTIS (U.S. Sales Only) $3.00.

Gamma and beta rays from the decay of ^{200}Au (48.4 min) were studied by employing Ge(Li) and plastic detectors in various singles and coincidence arrangements. The intensity of the β branch to the ground state of ^{200}Hg was determined as 79%; and the disintegration energy of ^{200}Au, to be Q_β = 2.26 ± 0.06 MeV. A tentative spin and parity assignment of $(1,2)^+$ is proposed for levels at 1515.2 and 1972.5 keV in ^{200}Hg. (auth) (2 figures, 1 table)

26292 EFFECTIVE INTERACTION BETWEEN NUCLEONS AND THE PROPERTIES OF NUCLEI NEAR LEAD. Isakov, V. I.; Kozhamkulov, T. A.; Sliv, L. A. (Ioffe Inst. of Physics and Tech., Leningrad). Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 10, 2157-2171(Oct 1972). (In Russian).

The properties of "^{208}Pb plus two nucleons", i.e., the nuclei ^{210}Po, ^{210}Pb, and ^{210}Bi, were studied within the framework of the shell model with allowance for some configuration mixing and core excitation. The radii and the parameters of central and tensor forces were determined. The role of the forces as being density-dependent was also explored. (8 figures) (tr-auth)

26293 HIGHER APPROXIMATIONS IN THE THEORY OF RADIATIVE AND CONVERSION TRANSITIONS OF NUCLEI. Krutov, V. A.; Fomenko, V. N. (Leningrad State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 10, 2190-2192(Oct 1972). (In Russian).

The contribution of "electron bridge" resonance processes to the probability of γ radiation by the system "nucleus plus electron shell" was calculated. The investigation was conducted for an N shell with Z = 80 and transition energies of 2 keV for E2, E3, and E4 transitions. (1 table) (tr-auth)

26294 NEW DATA ON NEAR-MAGIC NUCLEI. Sliv, L. A. (Leningrad Inst. of Nuclear Physics). Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 10, 2026-2035(Oct 1972). (In Russian).

An investigation of the collective, partial and mixed states in the region of Pb and Zr yielded some new results. The applicability of the shell model was demonstrated. Data on the splitting of multiplets rendered more accurate the form of effective interaction in the nucleus. Level schemes are presented for ^{208}Pb, ^{91}Zr, ^{210}Po, ^{210}Bi, and ^{211}At. (8 figures) (KSW)

26295 REACTIONS OF ^{16}O AND ^{12}C IONS WITH ^{208}Pb. Harvey, B. G.; Kovar, D. G.; Becchetti, F. D.; Puhlhoffer, P. G., Mahoney, J.; Faivre, J. C.; Zisman, M. S.; Sherman, J. D.; Mayer, B.; Miller, D. W.; Giorni, A.; Meriwether, J. R.; Cosper, S. W.; Marinescu, G. M. (Univ. of California, Berkeley). J. Phys. (Paris), Colloq.; No. 5, 80(1972).

Reactions induced by 104-MeV ^{16}O ions and 78-MeV ^{12}C ions on ^{208}Pb were studied. The angular distribution for the inelastic excitation of the ^{208}Pb 3^- (2.61 MeV) level by ^{16}O ions is shown. The cross sections are given for the proton stripping (^{16}O,^{15}N) and (^{12}C,^{11}B) reactions and the neutron pick-up (^{16}O,^{17}O) and (^{12}C,^{13}C) reactions. (FR)

26296 Pb ISOTOPES FORMED BY (HEAVY ION,xn) REACTIONS. Albouy, G.; Lagrange, J. M.; Pautrat, M.; Poffe, N.; Roulet, C.; Sergolle, H.; Vanhorenbeeck, J. (Paris Univ., Orsay, France). J. Phys. (Paris), Colloq.; No. 5, 106(1972). (In French).

The ^{200}Pb, ^{198}Pb, ^{196}Pb, ^{194}Pb isotope schemes presented were obtained from studies of the de-excitation of compound nuclei formed in ^{192}Os, ^{190}Os, ^{188}Os(^{12}C,4n), ^{186}W, ^{184}W, ^{182}W(^{16}O,4n), and ^{187}Re, ^{185}Re(^{14}N,5n) reactions. (FR)

26297 HIGH-ANGULAR-MOMENTUM STATES IN NEUTRON-DEFICIENT LEAD ISOTOPES. Albouy, G.; Lagrange, J. M.; Pautrat, M.; Roulet, C.; Sergolle, H.; Vanhorenbeeck, J. (Paris Univ., Orsay, France). J. Phys. (Paris), Colloq.; No. 5, 107 (1972). (In French).

Excited states of even neutron-deficient lead isotopes can be conveniently interpreted as a mixture of two-quasi-particle-state configurations constructed on the basis of the neutron states (holes) $p_{\frac{1}{2}}$, $f_{\frac{5}{2}}$, $p_{\frac{3}{2}}$, $i_{\frac{13}{2}}$, and $f_{\frac{7}{2}}$. (FR)

26298 RECOIL STUDY OF TRANSFER REACTIONS INDUCED WITH ^{40}Ar IN HEAVY NUCLEI. Bimbot, R.; Maison, J.; Rivet, M. F. (Paris Univ., Orsay, France). J. Phys. (Paris), Colloq.; No. 5, 56(1972).

The cross sections and recoil ranges of the residual nucleus ^{211}At were measured for the reactions ^{40}Ar + Bi and ^{40}Ar + Tl between 190 and 300 MeV. Angular distributions of ^{211}At were also measured for several incident energies. (FR)

26299 HEAVY ION TRANSFER REACTIONS ON ^{208}Pb AT ENERGIES WELL ABOVE THE COULOMB BARRIER. Scott, D. K.; Hudson, P. N.; Fisher, P. S.; Anyas-Weiss, N.; Panagiotou, A. D.; Brink, D. M. (Oxford Univ.). J. Phys. (Paris), Colloq.; No. 5, 58(1972).

The single-proton-transfer reactions ^{208}Pb(^{11}B,^{10}Be)^{209}Bi and ^{208}Pb(^{12}C,^{11}B)^{209}Pb and the single-neutron-transfer reactions ^{208}Pb(^{11}B,^{10}B)^{209}Pb and ^{208}Pb(^{12}C,^{11}C)^{209}Pb were studied at an incident energy of 115 MeV. Q values were determined. (FR)

26300 ELECTRON SCATTERING EFFECTS IN ANGULAR CORRELATIONS. Stefansson, V. (Univ. of Stockholm); Holmberg, L.; Pettersson, B. G.; Fogelberg, B. pp 685-693 of Radioactivity in Nuclear Spectroscopy. Vol. II. Hamilton, J. H. (Ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From International Conference on Radioactivity in Nuclear Spectroscopy; Nashville, Tennessee, United States of America (USA) (11 Aug 1969). See CONF-690818-(Vol. 2).

Electron–gamma and electron–electron angular correlations are influenced by electron scattering in the source material. It is necessary to use either sources thin enough to yield negligible scattering effects or a reliable method to correct for the attenuation caused by the possible scattering processes. The work reported was done to find a simple and precise method to determine the electron scattering effects in angular correlations. Results are tabulated, and the experimental relation between the scattering correction and the relative energy shift is shown for Al, Ag, and Au foils. There is a large discrepancy between the experimental results and the theory. (1 figure, 1 table) (RWR)

26301 REVIEW OF PRECISION EXPERIMENTAL TESTS OF CONVERSION COEFFICIENTS. Manthuruthil, J. C.; (Aerospace Research Labs., Wright Patterson Air Force Base, OH); Hamilton, J. H. pp 753-780 of Radioactivity in Nuclear Spectroscopy. Vol.

II. Hamilton, J. H. (Ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From International Conference on Radioactivity in Nuclear Spectroscopy; Nashville, Tennessee, United States of America (USA) (11 Aug 1969). See CONF-690818-(Vol. 2).

After a general introductory discussion, K-conversion coefficient measurements, L- and M-subshell ratio measurements, and K/L and L/M ratio measurements are reviewed. Consideration is restricted to pure transitions in which the spin of one of the states involved is zero, such as in a $2^+ \rightarrow 0^+$ transition. Nearly all the measurements that meet this requirement are for E2 transitions. Only those values that are measured to better than 5% accuracy are included. The measurements are compared with published calculations wherever available. (12 figures, 5 tables, 64 references) (RWR)

26302 HIGH PRECISION RELATIVE INTENSITY MEASUREMENTS FOR TRANSITIONS FOLLOWING ^{192}Ir DECAY. Willett, J. B.; Emery, G. T. (Indiana Univ., Bloomington). pp 1253-1257 of Radioactivity in Nuclear Spectroscopy. Vol. II. Hamilton, J. H. (Ed.). New York; Gordon and Breach Publishers, Inc. (1972).

From International Conference on Radioactivity in Nuclear Spectroscopy; Nashville, Tennessee, United States of America (USA) (11 Aug 1969). See CONF-690818-(Vol. 2).

26303 MULTIPOLE MIXING RATIO OF $2'^+ \rightarrow 2^+$ TRANSITIONS IN ^{194}Pt AND ^{196}Pt. Hamilton, W. D. (Univ. of Sussex, Brighton, Eng.). pp 1259-1264 of Radioactivity in Nuclear Spectroscopy. Vol. II. Hamilton, J. H. (Ed.). New York; Gordon and Breach Publishers, Inc. (1972).

From International Conference on Radioactivity in Nuclear Spectroscopy; Nashville, Tennessee, United States of America (USA) (11 Aug 1969). See CONF-690818-(Vol. 2).

26304 COMPARISON OF $2^+ - 2^+$ TRANSITION PROPERTIES IN ^{184}W, ^{190}Os, ^{192}Pt, AND ^{194}Pt. Zupancic, M. (Boris Kidric Inst. of Nuclear Sciences, Belgrade); Vukanovic, R.; Marinkov, L.; Krmpotic, D. pp 1265-1270 of Radioactivity in Nuclear Spectroscopy. Vol. II. Hamilton, J. H. (Ed.). New York; Gordon and Breach Publishers, Inc. (1972).

From International Conference on Radioactivity in Nuclear Spectroscopy; Nashville, Tennessee, United States of America (USA) (11 Aug 1969). See CONF-690818-(Vol. 2).

26305 LOW-LYING LEVELS OF ^{198}Hg. Beraud, R.; Berkes, I.; Haroutunian, R.; Marest, G.; Rougny, R. (Lyon Univ., Villeubanne, France). pp 1271-1277 of Radioactivity in Nuclear Spectroscopy. Vol. II. Hamilton, J. H. (Ed.). New York; Gordon and Breach Publishers, Inc. (1972).

From International Conference on Radioactivity in Nuclear Spectroscopy; Nashville, Tennessee, United States of America (USA) (11 Aug 1969). See CONF-690818-(Vol. 2).

26306 INVESTIGATION OF STRUCTURE OF SOME EXCITED STATES OF ^{208}Pb THROUGH RADIOACTIVITY EXPERIMENTS. Gupta, N. K.; Sastry, K. S. R. (Univ. of Massachusetts, Amherst). pp 1279-1283 of Radioactivity in Nuclear Spectroscopy. Vol. II. Hamilton, J. H. (Ed.). New York; Gordon and Breach Publishers, Inc. (1972).

From International Conference on Radioactivity in Nuclear Spectroscopy; Nashville, Tennessee, United States of America (USA) (11 Aug 1969). See CONF-690818-(Vol. 2).

26307 GAMMA–GAMMA DIRECTIONAL CORRELATIONS IN ^{214}Po USING A Ge(Li) DETECTOR. Gupta, N. K.; Sastry, K. S. R. (Univ. of Massachusetts, Amherst). pp 1285-1290 of Radioactivity in Nuclear Spectroscopy. Vol. II. Hamilton, J. H. (Ed.). New York; Gordon and Breach Publishers, Inc. (1972).

From International Conference on Radioactivity in Nuclear Spectroscopy; Nashville, Tennessee, United States of America (USA) (11 Aug 1969). See CONF-690818-(Vol. 2).

26308 L-SUBSHELL CONVERSION LINE INTENSITY RATIOS FOR THE 411.8 keV PURE E2 TRANSITION IN ^{198}Hg. Manthuruthil, J. C. (Aerospace Research Labs., Wright Patterson Air Force Base, OH); Geiger, J. S. pp 1363-1368 of Radioactivity in Nuclear Spectroscopy. Vol. II. Hamilton, J. H. (Ed.). New York; Gordon and Breach Publishers, Inc. (1972).

From International Conference on Radioactivity in Nuclear Spectroscopy; Nashville, Tennessee, United States of America (USA) (11 Aug 1969). See CONF-690818-(Vol. 2).

26309 TOTAL CONVERSION COEFFICIENT OF THE 375 keV TRANSITION IN ^{199m}Hg DECAY. Hankla, A. K. (Vanderbilt Univ., Nashville); Hamilton, J. H.; Fink, R. W. pp 1401-1404 of Radioactivity in Nuclear Spectroscopy. Vol. II. Hamilton, J. H. (Ed.). New York; Gordon and Breach Publishers, Inc. (1972).

From International Conference on Radioactivity in Nuclear Spectroscopy; Nashville, Tennessee, United States of America (USA) (11 Aug 1969). See CONF-690818-(Vol. 2).

26310 EFFECTIVE MOMENT OPERATOR FOR MAGNETIC MOMENTS AND M1 TRANSITIONS IN THE Pb REGION. Petrovich, F. (Univ. of California, Berkeley). Nucl. Phys.; A203: No. 1, 65-77(1973).

The effect of core polarization on magnetic moments in the Pb region is investigated using the first-order perturbation theory with a central zero-range coupling interaction. The results are expressed in the form of a state-dependent effective moment operator which includes an anomalous orbital g factor introduced previously. This operator gives a better account of the experimental data than a state-independent operator proposed earlier by Maier, et al., particularly in the case of the M1 transition rates, which are quite sensitive to the magnitude of the polarization. The force required to fit the data is somewhat larger than realistic interactions currently in use. (5 tables) (auth)

26311 RESULTS WITH A RADIAL TRANSMISSION MAGNET ON THE PARITY VIOLATION IN ^{180}Hf, ^{181}Ta, AND ^{203}Tl. Kuphal, E.; Daum, M.; Kankeleit, E. (Inst. for Technical Nuclear Physics, Darmstadt, Ger.). pp 299-305 of Symposium on Nucleons and Weak Interactions. Eman, B. (ed.). Zagreb; Institute Rudjer Boskovic (1971).

From Symposium on nucleons and weak interactions; Zagreb, Yugoslavia (Jul 1971). See CONF-710737-.

The small parity violation from nonleptonic weak interactions was studied by measuring the circular polarization of gamma rays from the 482-keV transition in tantalum-181, the 279-keV transition in thallium-203, and the 501-keV transition in hafnium-180. (JFP)

26312 CHARACTERISTICS OF THE α DECAY OF LIGHT ISOTOPES OF Bi, Pb, AND Th HAVING A < 195. Gauvin, H.; Le Beyec, Y.; Lefort, M.; Porile, N. T. (Paris Univ., Orsay, France). J. Phys. (Paris), Colloq.; No. 5, 94(1972). (In French).

Light Bi isotopes having atomic masses lying between 189 and 195 were produced by (Ar, xn) reactions induced on a ^{159}Tb target. Results were also obtained on the α radioactivity of light Pb isotopes (A < 193) and Th isotopes (A < 188) produced by Gd(Ar, xn) and Eu(Ar, xn) reactions. (FP)

26313 STUDIES OF SHORT-LIVED ISOMERS BY IN-BEAM GAMMA-RAY SPECTROSCOPY. Yamazaki, T. (Tokyo Univ.). pp 417-448 of Radioactivity in Nuclear Spectroscopy. Vol. I. Hamilton, J. H. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From International Conference on Radioactivity in Nuclear Spectroscopy; Nashville, Tennessee, United States of America (USA) (11 Aug 1969). See CONF-690818-(Vol.1).

In-beam γ-ray spectroscopy combined with the pulsed-beam method appears to be the most powerful and systematic way to study short-lived isomers ($t_{\frac{1}{2}} \gtrsim$ ns). In particular, the use of continuum compound reactions favors population of such isomeric states that would otherwise be hidden. In addition to a brief review of the experiments in the μs–ms range, the recent developments in the ns range are surveyed. This method consists of the use of sharp natural bunches of cyclotron beams (the time spread $\lesssim$3 ns) and of fast electronics in conjunction with Ge(Li) detectors. Some aspects of high-spin isomers are discussed from the viewpoint of nuclear structure. The fact that isomeric states formed in beam are oriented at t = 0 can be used to study nuclear moments and hyperfine interactions. Some measurements of magnetic moments of high-spin isomers are described. The increasing number of isomers of various time ranges will play an important role as probes to study hyperfine interactions. (18 figures) (auth)

26314 RESONANCES EFFECTS IN MESIC ATOMS. Electromagnetic Properties of ^{209}Bi and Thallium Isotopes. Tomaselli, M.; Herold, D. (Technische Univ., Darmstadt, Ger.). J. Phys. (Paris), Colloq.; No. 5, 169(1972).

The values of the magnetic moments of seven excited states in ^{209}Bi obtained with different core wave functions are presented. (FR)

26315 SMALL-ANGLE SCATTERING OF FAST NEUTRONS BY Bi AND Pb. Drigo, L.; Manduchi, C.; Moschini, G.; Russo-Manduchi, M. T.; Tornielli, G.; Zannoni, G. (Univ., Padua). Nuovo Cim.; 13A: No. 4, 867-876(21 Feb 1973).

Differential cross sections and polarizations of 2.45-MeV neutrons elastically scattered by Bi and Pb were measured for scat-

tering angles of 2.1, 3, and 5°. Energy separation was accomplished by conventional time-of-flight techniques. The results, when compared with the predictions of the electromagnetic interaction, indicate some deviation of $\sigma(\theta)P(\theta)$ from the expected values, at least for the lowest angle. The observed cross sections are systematically greater than those evaluated from the optical model, even if one takes into account the electromagnetic contribution. (4 figures, 1 table) (auth)

Nuclear Properties and Reactions, A ≥ 220

Refer also to abstracts 24482, 24708, 24772, 24791, 25605, 25622, 25634, 26103, 26130, 26144, 26150, 26190, 26194, 26222, 26223, 26229, 26235, 26249, 26261, 26274, 26280, 26301, 26353, and 26409.

26316 (BARC-628, pp 80-116) NUCLEAR CHEMISTRY. 1972.

Radiochemical and track detector studies on fission are emphasized. The areas studied included the following: recoil ranges and kinetic energy distribution in the reactor neutron fission of ^{237}Np; recoil ranges of isobar pairs in the thermal neutron fission of ^{235}U; studies on highly asymmetric binary fission–fission of natural uranium with reactor neutrons; fission cross section for the thermal and 14-MeV neutron-induced fission of ^{231}Pa; mass and angular distribution in fission using correlated fission track technique; analysis of angular distribution data at 15.8 MeV; and thermal neutron flux distribution at the thermal column at Apsara. The calibration and efficiency of Ge(Li) detectors for gamma spectroscopy and studies on the electrodeposition of actinide elements are also reported. (15 figures, 6 tables) (RWR)

26317 (CONF-720404-(Vol. 1), pp 396-413) IN-FLIGHT X RAY MEASUREMENTS: A TECHNIQUE FOR IDENTIFICATION OF RECOIL PRODUCTS, e.g., SUPERHEAVY ELEMENTS. Armbruster, P. (Gesellschaft fuer Schwerionenforschung, Darmstadt, Ger.); Mokler, P. H.; Stein, H. J. Jan 1973.

From International conference on inner shell ionization phenomena and future applications; Atlanta, Georgia, USA (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

In energetic heavy-ion-atom collisions there is an extremely high probability of producing vacancies in inner shells of the collision partners. The resulting high x-ray yield opens up the possibility of detecting unknown isotopes, e.g., superheavy elements, by their collision-induced characteristic x-rays. A Z determination of fast recoils with lifetimes longer than 10^{-6} sec seems to be possible. The applicability of the method in different mass regions is discussed here. (auth)

26318 (CONF-720404-(Vol. 1), pp 680-693) L-AUGER SPECTRA OF Pu, Am, Cf, AND Fm. Freedman, M. S.; Porter, F. T. (Argonne National Lab., Ill.). Jan 1973.

From International conference on inner shell ionization phenomena and future applications; Atlanta, Georgia, USA (17 Apr 1972).

In Proceedings of the International conference on inner shell ionization phenomena and future applications.

L-Auger spectra have been studied at high resolution (0.5 to 0.2% in momentum) from the decays, ^{239}Am(e.c.)^{239}Pu, ^{241}Cm(e.c.)^{241}Am, ^{250}Es(e.c.)^{250}Cf and ^{254m}Es(β^-)^{254}Fm. All samples were deposited as ions decelerated to ~100 eV after isotope separation. About 50-100 L Auger lines were resolved in each spectrum. The energies are correlated with the values calculated from electron binding energies which are mainly evaluated in the same experiments via conversion electron spectroscopy. Intensities are compared to theoretical predictions of McGuire. "Spectator vacancy" satellite lines are resolved from normal L Augers in L_2 and L_3 lines and, as expected, none are seen in L_1 Augers. (auth)

26319 (CONF-720404-(Vol. 3), pp 1859-1867) CONVERSION ELECTRON INTENSITY RATIOS OF THE $2^+ \rightarrow 0^+$, E2 TRANSITION IN ^{234}U. Hamilton, J. H. (Vanderbilt Univ., Nashville); LaCasse, W. M.; Geiger, J. S.; Graham, R. L.; Amtey, S. R. Jan 1973.

From International conference on inner shell ionization phenomena and future applications; Atlanta, Georgia, USA (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

The L, M and N subshell ratios of the 43.5-keV E2 transition in ^{234}U have been measured in an iron-free, double focusing spectrometer. The following ratios were obtained $L_1/L_2/L_3 = 3.51(24)/114.0(20)/100$, $M_1/M_2/M_3/M_4/M_5 = 4.18(18)/105.6(16)/100/1.56(10)/0.96(8)$, $N_1/N_2/N_3/N_{4\&5} = 8(3)/210(6)/210/6(1)$, and $L_3/M_3/N_3/\Sigma O/\Sigma P+Q = 243/66(2)/18.5(6)/8.8(5)/1.76(18)$. The ratios are compared with the various theoretical calculations. (auth)

26320 (CONF-720404-(Vol. 3), pp 1906-1929 INTERNAL CONVERSION ELECTRONS: ENERGY SHIFT AND NUCLEAR HALF LIFE IN IONIZED ATOMS–MULTIPLE DEEP VACANCY PRODUCTION THROUGH SECOND ORDER EFFECTS. Walen, R. J.; Briancon, C.; Valadares, M. (Centre de Spectrometrie Nucleaire et de Spectrometrie de Masse, Orsay, France). Jan 1973.

From International conference on inner shell ionization phenomena and future applications; Atlanta, Georgia, USA (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

We report here on two effects in which internal conversion electrons generate multiple vacancies and are the means of detecting energy shifts. The first effect, of first order, uses two succeeding conversions, one of which gives rise to intense peeling, the second conversion measuring the resulting energy shift. In the second effect, the conversion electron creates multiple deep vacancies by a second order process, and the energy shift is observed on this electron itself. More or less, this is a rare event of the first step of the first mentioned effect. Narrow limits are put on this report, the subjects being related to research domains which have grown enormously in the last decades (respectively beam foil techniques and external excitation). (auth)

26321 (CONF-720404-(Vol. 3), pp 1948-1956) MULTIPOLARITY DETERMINATION FROM L X-RAY SPECTRA IN ^{249}Cf DECAY. Schmidt-Ott, W.-D.; McGeorge, J. C.; Fink, R. W. (Georgia Inst. of Tech., Atlanta). Jan 1973.

From International conference on inner shell ionization phenomena and future applications; Atlanta, Georgia, USA (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

A new method to determine the multipolarity of a converted gamma transition from its L x-ray spectrum has been extended to a coincidence method and applied in the complex decay of ^{249}Cf. The L x-ray spectra of the 54.7 keV transition (first rotational band) and of the 54.7 keV transition (third rotational band) have been measured in coincidence with cascading high energy γ-rays and their multipolarity obtained by comparison with calculated line intensities. For the $9/2^+ \rightarrow 7/2^+$ groundstate transition in ^{245}Cm, admixtures of (63 ± 10)% E2 and for the $11/2^- \rightarrow 9/2^-$ transition in the third rotational band of (32 ± 10)% E2 have been obtained. (auth)

26322 (COO-3463-10) NEUTRON AND GAMMA EMISSION FROM HIGHLY EXCITED STATES AND STATES WITH HIGH SPIN. Annual Progress Report. Sperber, D. (Rensselaer Polytechnic Inst., Troy, N. Y.). 1972. Contract AT(11-1)-3463. 5p. Dep. NTIS $3.00.

The following subjects are discussed very briefly: the study of nuclei far off the beta stability line synthesized in heavy-ion reactions; the statistical theory for the ratio of isomer to prompt and neutron to prompt cross section; the study of isomer ratios for shape isomers in (n,γ) reactions; the study of the intermediate state in fission; heavy-ion reactions in the actinide region; the role of isospin in the unified model for the statistical decay of the compound nucleus; and the cross section for the synthesis of superheavy elements in heavy-ion reactions. Some of the above work has already been published or is in press; the last two items are still in preliminary stages of work. (RWR)

26323 (DP-1309) CALCULATION OF ^{236}Pu IN ^{238}Pu PRODUCED BY ^{237}Np IRRADIATIONS. Paulson, C. K. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.). Dec 1972. Contract AT(07-2)-1. 38p. Dep. NTIS $3.00.

A method was developed to calculate ^{236}Pu formed during ^{237}Np irradiations to produce ^{238}Pu. The method was applied to production and power reactor irradiations, and provided excellent agreement with experimental values. ^{236}Pu is formed by fast-neutron and gamma reactions in which the initiating particle must have an energy >6.8 MeV. These high-energy particles can originate in the neptunium target and in surrounding materials, and their contributions to ^{236}Pu formation are calculated separately. Consideration was also given to the effects on ^{236}Pu formation of variations in the spectra of high-energy neutrons and gamma rays. (2 figures, 13 tables) (auth)

26324 (LA-5134) GAMMA-RAY PRODUCTION CROSS SECTIONS FOR 5- TO 8-MeV NEUTRON INTERACTIONS WITH ^{235}U.

Drake, D. M. (Los Alamos Scientific Lab., N. Mex.). Feb 1973. Contract W-7405-eng-36. 6p. Dep. NTIS $3.00.

Neutron-induced gamma-ray production cross sections for neutrons with energies of 5 to 8 MeV were measured for ^{235}U. The results are compared with estimates based on evaluated cross sections. (3 figures, 2 tables) (auth)

26325 γ-RAY SPECTRUM OF ^{225}Ac. Dzhelepov, B. S.; Ivanov, R. B.; Mikhailova, M. A.; Sergeev, V. O. Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 10, 2080-2088(Oct 1972). (In Russian).

The γ-ray spectrum of ^{225}Ac was measured with a γ spectrometer with a Ge(Li) detector and a resolution of 600 eV. The γ-ray intensity and energy data were refined, a portion of which was determined for the first time. The multipole orders and intensities of γ transitions of ^{221}Fr were measured. The intensities of x radiation of the K series are given for the daughter products of ^{225}Ac. (4 figures, 5 tables) (tr-auth)

26326 INTERMEDIATE STRUCTURES IN FISSION: SPECTROSCOPY OF SHAPE ISOMERS. Bjoernholm, S. (Niels Bohr Institutet, Copenhagen). J. Phys. (Paris), Colloq.; No. 5, C5.33-C5.44(1972).

The spectroscopy of rotational and intrinsic states constructed on spontaneously fissioning isomers is reviewed on the basis of available experimental data. The ground-state rotational band, the k-isomers, the vibrational excitations and the compound levels are discussed for doubly even nuclei. The single neutron excitations are discussed and compared with the Nilsson diagram for large distortions in the case of odd-neutron nuclei. (FR)

26327 NUCLIDES FAR OFF THE STABILITY LINE AND SUPER-HEAVY NUCLEI IN HEAVY-ION NUCLEAR REACTIONS. Lefort, M. (Paris Univ., Orsay, France). J. Phys. (Paris), Colloq.; No. 5, C5.73-C5.102(1972).

The numerous new nuclei produced during recent years by using heavy-ion reactions are reviewed: exotic neutron-rich light nuclei, intermediate-mass nuclei emitting protons and α particles, heavy nuclei and superheavy nuclei. The possible limits to the production of very-neutron-deficient nuclei or highly deformed nuclei in the rare earth region are discussed together with the new possibilities available using heavier ion beams ^{40}Ar, ^{40}Ca, ^{84}Kr, ^{136}Xe, etc. In the case of heavy nuclei in the region between Ta and U, the important competition between the fission and high rotation energy introduced by the large angular momenta of the heavy projectiles limits the possibilities of synthesis. A brief description is given of attempts made to produce superheavy nuclei. (FR)

26328 SEMI-EMPIRICAL SHELL CORRECTION IN THE FISSION OF HEAVY AND SUPERHEAVY NUCLEI. Schultheis, R.; Schultheis, H. (Univ., Munich). J. Phys. (Paris), Colloq.; No. 5, 5(1972).

A semiempirical correction for the nonuniform distribution of single-particle levels in nuclei was studied. The results are similar to those obtained using the Strutinsky method. (FR)

26329 EQUILIBRIUM QUADRUPOLE AND HEXADECAPOLE DEFORMATIONS IN ACTINIDE NUCLEI. Milner, W. T.; McGowan, F. K.; Bemis, C. E.; Ford, J. L. C.; Robinson, R. L.; Stelson, P. H.; (Oak Ridge National Lab., TN). J. Phys. (Paris), Colloq.; No. 5, 112(1972).

It is shown that electric quadrupole and hexadecapole moments in the actinide deformed region may be reliably extracted from precision Coulomb excitation experiments using ^{4}He ion projectiles. (FR)

26330 SEARCH FOR SUPER-HEAVY COMPOUND NUCLEI USING IN-FLIGHT MASS SPECTROMETRY. Colombani, P.; Gatty, B.; Jacmart, J. C.; Lefort, M.; Peter, J.; Riou, M.; Stephan, C.; Tarrago, X. (Paris Univ., Orsay, France). J. Phys. (Paris), Colloq.; No. 5, 91(1972). (In French)

An experiment is described for detecting and identifying superheavy compound nuclei in terms of their mass, these nuclei being formed by the fusion of incident ^{84}Kr nuclei (450 to 500 MeV) with U or Th target nuclei. (FR)

26331 ELASTIC SCATTERING OF ^{84}Kr BY HEAVY NUCLEI. Colombani, P.; Jacmart, J. C.; Poffe, N.; Riou, M.; Stephan, C.; Tys, J. (Paris Univ., Orsay, France). J. Phys. (Paris), Colloq.; No. 5, 43(1972). (In French).

The angular distributions of ^{84}Kr ions elastically scattered from ^{232}Th and ^{181}Ta targets were measured for energies slightly above the Coulomb barrier. In this way information was obtained about the increase in the reaction threshold for the very heavy ions observed in superheavy nuclei-seeking experiments. (FR)

26332 RATIO OF THE TERNARY (LRA) TO BINARY FISSION CROSS SECTION FOR ^{235}U IN THE RESONANCE REGION (BELOW 40 eV). Wagemans, C. (CEN, Mol, Belgium); Deruytter, A. J. J. Phys. (Paris), Colloq.; No. 5, 19(1972).

Precise measurements were performed of the ratio of ternary to binary fission T/B for ^{235}U in the neutron energy region below 40 eV. (FR)

26333 PROMPT ELECTRONS FROM NEUTRON-INDUCED FISSION OF ^{235}U. Khan, T. A. (Kernforschungszentrum, Karlsruhe, Ger.); Horsch, F.; Hofmann, D. J. Phys. (Paris), Colloq.; No. 5, 30(1972).

The internal conversion electrons emitted by ^{235}U fission fragments were detected, and their energy spectra were studied as a function of the fragment mass. The resolution was high enough to obtain the K/L internal conversion ratios and to assign multipolarities to the corresponding transitions. An attempt was made to determine the charge of the fragments. (FR)

26334 DECAY PROPERTIES AND YIELDS OF SHORT-LIVED FISSION PRODUCTS IN THE 50- AND 82- NEUTRON-SHELL REGION IN THERMAL-NEUTRON INDUCED FISSION OF ^{235}U. Franz, H.; Herrmann, G.; Kratz, J. V.; Kratz, K. L. (Univ., Mainz). J. Phys. (Paris), Colloq.; No. 5, 31(1972).

Rapid radiochemical separation procedures were used to identify short-lived isotopes (As, Se, Br, I) having half-lives as low as 1 second [e.g. $^{86}As(T_{\frac{1}{2}} = 0.9$ s), $^{88}Se(T_{\frac{1}{2}} = 1.4$ s), $^{92}Br(T_{\frac{1}{2}} = 0.25$ s), and $^{141}I(T_{\frac{1}{2}} = 0.45$ s)] among the fission products of ^{235}U. (FR)

26335 CONDITIONS FOR THE FORMATION OF SUPER-HEAVY COMPOUND NUCLEI WITH A Kr BEAM. Tamain, B.; Lefort, M.; Ngo, C.; Peter, J. (Paris Univ., Orsay, France). J. Phys. (Paris), Colloq.; No. 5, 50(1972). (In French).

The elastic scattering cross section at 162° for Kr ions was studied as a function of the incident energy; the effective elastic scattering barrier is equal to 335 ± 7 MeV cm. The bombarding energy region where the observed heavy-nucleus-formation cross section has its maximum value is limited to a few dozen MeV above the compound-nucleus-formation threshold. (FR)

26336 EXPERIMENTAL STUDY OF THE POTENTIAL ENERGY SURFACE FOR THE SCISSION CONFIGURATIONS. Nifenecker, H.; Babinet, R.; Signarbieux, C. (CEN de Saclay, Gif-sur Yvette, France). J. Phys. (Paris), Colloq.; No. 5, 25(1972).

An experimental study of fissioning nuclei was performed in order to test the predictions of a simple double-spheroid model. The results show that the nuclear system tends to occupy the maximum volume in phase space at scission. (FR)

26337 DETAILED INVESTIGATION ON PROMPT NEUTRON NUMBER DISTRIBUTION AS A FUNCTION OF FRAGMENT CHARGE IN THE SPONTANEOUS BINARY AND TERNARY FISSION OF ^{252}Cf. Poitou, J.; Girard, J.; Nifenecker, H.; Signarbieux, C. (CEN de Saclay, Gif-sur-Yvette, France). J. Phys. (Paris), Colloq.; No. 5, 28(1972).

The x-rays emitted in the binary and ternary fission of ^{252}Cf were measured in two parallel experiments. The total number of neutrons evaporated from the fragments was also measured. The ratios of the x-ray intensities for the different pairs of complementary charges were calculated for the light and heavy fragments as a function of the number of detected neutrons. (FR)

26338 EVEN—ODD EFFECTS IN THE PROMPT DE-EXCITATION PROCESS OF THE FISSION FRAGMENTS OF ^{252}Cf. Nifenecker, H.; Girard, J.; Matuszek, J.; Ribrag, M. (CEN de Saclay, Gif-sur-Yvette, France). J. Phys. (Paris), Colloq.; No. 5, 29(1972).

When an even–even nucleus undergoes fission, the two fragments have both an even or an odd number of protons and neutrons. In particular, fission giving rise to fragments with even charges will be, on the average, about 2.5 MeV more energetic than those giving rise to fragments with odd charges. The results obtained confirm the absence of any significant even–odd effect on the average neutron number. A pronounced effect is, however, observed for the total gamma-ray energies. This effect, which is associated with an energy of the order of 1 MeV, does not fully account for the total even–odd effect, which is associated with an energy of about 2.5 MeV. (FR)

26339 MEASUREMENTS OF LIFETIMES AND GAMMA ENERGIES OF NEUTRON-RICH NUCLEI PRODUCED IN THE FISSION PROCESS. Albinsson, H. (CEN de Saclay, Gif-sur-Yvette, France). J. Phys. (Paris), Colloq.; No. 5, 32(1972).

Measurements were made on the gamma radiation emitted from fragments in the slow-neutron-induced fission of ^{235}U. In another measurement, the yield of prompt photons having half-lives of about 20 ps was studied as a function of the total kinetic energy of the fragments. The yield is very dependent on the mass region studied. (FR)

26340 SUBNANOSECOND AND NANOSECOND DOUBLE FISSION ISOMER. In the Even–Even ^{238}Pu. Limkikde, P.; Sletten, G. (Niels Bohr Institutet, Copenhagen). J. Phys. (Paris), Colloq.; No. 5, 7(1972).

A new isomer of ^{238}Pu was discovered in the $(\alpha,2n)$ reaction with ^{236}U. Its half-life was found to be 0.5 ns. (FR)

26341 REMOVAL OF THE SPURIOUS STATE FROM THE CRANKING MASS FORMULA. Dickmann, F. (Kernforschungszentrum, Karlsruhe, Ger.); Hara, K.; Hoffmann, H. J. Phys. (Paris), Colloq.; No. 5, 15(1972).

The conventional cranking mass formula for heavy nuclei was compared with a formula improved by the PPA formalism. Calculations were made for ^{240}Pu. (FR)

26342 VARIATION IN FRAGMENT TOTAL KINETIC ENERGY WITH EXCITATION ENERGY IN FISSION OF ^{240}Pu INDUCED BY THE $^{239}Pu(d,pf)$ REACTION. Milton, J. C. D.; Fraser, J. S.; Specht, H. J. (Atomic Energy of Canada Ltd., Chalk River, Ont.). J. Phys. (Paris), Colloq.; No. 5, 17(1972).

A 13-MeV beam of deuterons was used to search for variations in the total fragment kinetic energy with excitation energy in the reaction $^{239}Pu(d,pf)$. No evidence for fine structure with a width greater than 300 keV was seen. (FR)

26343 SPIN ASSIGNMENTS OF ^{235}U NEUTRON RESONANCES AND ESTIMATE OF (Γ_f) FOR $J^\pi = 3^-$ AND 4^- LEVELS. Corvi, F.; Stefanon, M.; Coceva, C.; Giacobbe, P. (Commission of the European Communities, Geel, Belgium). J. Phys. (Paris), Colloq.; No. 5, 20(1972).

Since the ground state of ^{235}U has spin and parity $I^\pi = \frac{7}{2}^-$, the s-wave neutron resonances which dominate the slow neutron-induced fission of ^{235}U correspond to levels of ^{236}U with $J^\pi = 3^-$ and 4^-. Knowledge of the spins of a considerable sample of such resonances is necessary in order to give an estimate of the average fission widths for the two spin states. In order to assign resonance spins, the low level population method was applied to ^{235}U. (FR)

26344 MEASUREMENT OF THE VARIATION IN THE MEAN NUMBER OF PROMPT NEUTRONS EMITTED DURING THE RESONANCE NEUTRON INDUCED FISSION OF ^{239}Pu. Trochon, J.; Lucas, B.; Michaudon, A. (CEN de Saclay, Gif-sur-Yvette, France). J. Phys. (Paris), Colloq.; No. 5, 23(1972).

The time-of-flight neutron method (10 eV to 300 eV) was used to measure the mean number of prompt neutrons emitted in ^{239}Pu s resonances. The experiments were performed in view of verifying the Bohr theory. (FR)

26345 VARIATIONS IN PROMPT NEUTRON AND GAMMA-RAY YIELDS IN RESONANCE NEUTRON-INDUCED FISSION OF ^{239}Pu. Shackleton, D.; Frehaut, J.; Le Bars, M. (CEN de Saclay, Gif-sur-Yvette, France). J. Phys. (Paris), Colloq.; No. 5, 24 (1972).

The mean number of prompt fission neutrons emitted in ^{239}Pu resonances was measured. An accuracy exceeding the 2% estimated from the kinetic energy of the fission fragments is expected for more than 20 resonances. (FR)

26346 NEW RESULTS ON THE PROMPT NEUTRON EMISSION BY THE INDIVIDUAL FISSION FRAGMENTS OF ^{252}Cf. Signarbieux, C.; Nifenecker, H.; Poitou, J.; Ribrag, M. (CEN de Saclay, Gif-Sur-Yvette, France). J. Phys. (Paris), Colloq.; No. 5, 25(1972).

Measurements were made in order to study the variance of the prompt neutron number distribution as a function of the mass of the fragments and their kinetic energies. The principal aim of the experiment was to obtain precise information on the correlation between the excitation energies of the complementary fragments. (FR)

26347 IDENTIFICATION OF A ROTATIONAL BAND IN THE ^{240m}Pu FISSION ISOMER. Specht, H. J. (Univ., Munich); Weber, J.; Konecny, E.; Heunemann, D. J. Phys. (Paris), Colloq.; No. 5, 8(1972).

Direct experimental evidence demonstrating that isomeric fission is connected with nuclear deformations larger than the equilibrium ground-state deformation is presented. In order to identify rotational bands in the second minimum of the nuclear potential energy surface, delayed coincidences were measured between conversion electrons and fission fragments using the $^{238}U(\alpha,2n)^{240m}Pu$ reaction. (FR)

26348 RESONANCES ABOVE THE FISSION THRESHOLDS OF ^{232}Th, ^{231}Pa, AND ^{234}U FOR FAST NEUTRONS. Doan, T. P.; Sicre, A.; Leroux, B.; Chastel, R. (Univ., Bordeaux). J. Phys. (Paris), Colloq.; No. 5, 13(1972). (In French).

The results of Hoffmann and Dietrich concerning the variation of the inertia parameter were used to interpret the structure of the fission cross section curve in the vicinity of the reaction threshold. (FR)

26349 ESTABLISHMENT OF THE EXISTENCE OF AN INTERMEDIATE STRUCTURE IN THE FISSION CROSS SECTION OF ^{239}Pu. Bions, J.; Derrien, H.; Michaudon, A. (CEN de Saclay, Gif-sur-Yvette, France). J. Phys. (Paris), Colloq.; No. 5, 22 (1972). (In French)

Confirmation of the existence of an intermediate structure in the fission cross section of ^{239}Pu was obtained from two tests. This structure is due to the 1^+ exit channel(s); the Wald and Wolfowitz test demonstrates that there is no intermediate structure in the entrance channel. (FR)

26350 PROMPT FISSION NEUTRON ENERGY SPECTRUM OF ^{235}U AT $E_N = 0.4$ MeV. Knitter, H. H.; Islam, M. M. (Commission of the European Communities, Geel, Belgium). J. Phys. (Paris), Colloq.; No. 5, 33(1972).

The fission-neutron spectrum of ^{235}U for incident neutrons having an energy of 0.4 MeV was studied. (FR)

26351 LOW-ENERGY γ-RAYS AND SPINS OF ^{235}U NEUTRON RESONANCES. Corvi, E.; Stefanon, M.; Coceva, C.; Giacobbe, P. (CBNM-EURATOM, Geel, Belgium). Nucl. Phys.; A203: No. 1, 145-163(1973).

Low-energy prompt γ-ray spectra in the range 95 to 670 keV were measured for forty-one ^{235}U neutron resonances selected by time of flight in the neutron energy range 1.5 to 58 eV. Discrimination against the natural γ activity of ^{235}U was obtained by means of a coincidence technique. The spectra show a very complicated structure owing to a few capture and many fission γ rays. The ratios of the intensities of the 160.3-keV and 642.4-keV capture γ rays were used for spin assignments of fourteen resonances with small fission widths. Some conclusions were drawn about the spin dependence of average fission widths, anisotropy of fission fragments, and symmetric fission yields. (9 figures, 1 table) (auth)

26352 COMPUTER PROGRAM FOR ANALYSIS AND INTERPRETATION OF FISSION DATA. Lightbody, D.; Alexander, P.; Patton, W. A. (Columbia Univ., New York). pp 225-30 of Radioactivity in Nuclear Spectroscopy. Vol. I. Hamilton, J. H. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From International Conference on Radioactivity in Nuclear Spectroscopy; Nashville, Tennessee, United States of America (USA) (11 Aug 1969). See CONF-690818-(Vol.1).

An important part of the experimental information pertaining to the fission process is the measurement of direct yields to various mass chains. One technique for obtaining this information requires fast radiochemical separation of one or more species from the bulk fission products. In order to extract direct yield information from the measured population of the separated species, chain ingrowth contributions must be subtracted. The time-dependent magnitude of this ingrowth is a function of the distribution of direct yield among the precursors. In mass chains involving complex multilink decay schemes, calculation of the time-dependent population for each state can be very difficult. To aid in the analysis and interpretation of experimental population data, a computer program was written which calculated the population of all members of the decay chain as a function of time for any initial population distribution. This calculation can be performed for a decay sequence consisting of up to 12 states, linked in any physically allowable fashion. The second phase of the program uses as input the time-dependent populations measured for one or more members of the decay chain. The direct yield to members of this chain is assumed to follow a Gaussian charge distribution. The centroid value and half-width of this distribution are least-squares fitted to the experimental population data. Application of these programs to mass chains 133 and 135 is discussed. (2 figures) (auth)

26353 STUDY OF COMPLEX DECAY SCHEMES BY $\gamma-\gamma$ COINCIDENCE MEASUREMENTS USING A 16 K MEMORY SYSTEM. Kaffrell, N.; Denig, R.; Herrmann, G.; Trautmann, N. (Univ., Mainz). pp 395-407 of Radioactivity in Nuclear Spectroscopy. Vol. I. Hamilton, J. H. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From International Conference on Radioactivity in Nuclear

Spectroscopy Nashville, Tennessee, United States of America (USA) (11 Aug 1969). See CONF 690818-(Vol.1).

The decay of several short-lived nuclides was investigated employing Ge(Li) detectors and coincidence techniques. For the $\gamma-\gamma$ coincidence experiments a Honeywell 16K memory system with 16 digital windows was used. This equipment was preferred to an on-line computer technique, as a large number of experiments over a range of several days or weeks had to be done. Either the chemical separation of the isotopes under investigation or the decay of the undesired longer-lived components produced in the target during irradiation takes plenty of time, so that an external computer memory cannot be used. The decay properties of 3.0-min ^{164}Tb and 2.3-min ^{238}Pa serve as examples of these investigations. These nuclides were produced by the reactions ^{164}Dy (n,p) and ^{238}U(n,p) by bombardment with 14-MeV neutrons. While in the case of the 2.3-min ^{238}Pa an isolation from the fission products and the uranium was required, the 3.0-min ^{164}Tb was measured without chemical separation. For both nuclides a detailed decay scheme is proposed, and a discussion of the structure of some levels is given. In the level scheme of ^{164}Dy, besides the ground-state band, the γ-vibrational and a $K^\pi = 2^-$ octupole band, and some two-quasi-particle levels, a possible $k^\pi = 4^-$ two-phonon state at 1588.1 keV and a fairly pure four-quasi-particle state with $K^\pi = 4^+$ and the configuration [523↓], [633↑], [411↑], [523↑] were identified. The four-quasi-particle state is fed by an allowed β transition of the type "au" with a log-ft value of 4.8. In the level scheme of ^{238}U only scanty information could be obtained from Coulomb excitation and fast-neutron scattering experiments. Over 20 levels were found, including three low-energy octupole bands with $K^\pi = 0^-$, 1^-, and 2^- at 680.2, 930.8, and 1128.7 keV, respectively. Furthermore, three members of the γ-vibrational band at 1060.9 keV and some two-quasi-particle states were identified. (9 figures) (auth)

26354 MASS DISTRIBUTION OF ^{235}U FISSION INDUCED BY EPITHERMAL NEUTRONS, AS DEDUCED FROM THE DETAILED GAMMA SPECTRUM OF THE FISSION PRODUCTS. Van Assche, P. H. M.; De Coster, M.; Brandt, C. (SCK-CEN, Mol, Belg.). pp 573-578 of Radioactivity in Nuclear Spectroscopy. Vol. I. Hamilton, J. H. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From International Conference on Radioactivity in Nuclear Spectroscopy; Nashville, Tennessee, United States of America (USA) (11 Aug 1969). See CONF 690818-(Vol.1).

The gamma-ray spectrum from the decay of ^{235}U (n,f) fission products was analyzed by a Ge (Li) detector, without any previous chemical separation. Two hundred fifty gamma lines were identified, half of which were assigned to known fission products; the assignment rests on the correspondence of the measured energies and half-lives with previously published values. Fission products of at least 22 different mass numbers could be observed. A variation of the mass distribution of the ^{235}U fission, when going from thermal to epithermal neutron energy, has been suggested previously. Thanks to an improved precision, this effect is firmly established in the present experiment. The computer analysis of these rather complicated spectra is highly improved by the introduction of fixed line widths (fwhm). (2 figures, 1 table) (auth)

26355 SATELLITE BANDS OF CONVERSION LINES IN THE ^{241}Am → ^{237}Np α DECAY. Briancon, C.; Walen, R. J. (Centre de Spectrometrie Nucleaire et de Spectrometrie de Masse, Orsay, France). pp 791-796 of Radioactivity in Nuclear Spectroscopy. Vol. II. Hamilton, J. H. (Ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From International Conference on Radioactivity in Nuclear Spectroscopy; Nashville, Tennessee, United States of America (USA) (11 Aug 1969). See CONF-690818-(Vol. 2).

26356 DIRECT POPULATION OF THE $h_{\frac{11}{2}}$ STATES IN ^{133}Xe AND ^{135}Xe THROUGH THERMAL NEUTRON FISSION. Alexander, P. pp 1225-1230 of Radioactivity in Nuclear Spectroscopy. Vol. II. Hamilton, J. H. (Ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From International Conference on Radioactivity in Nuclear Spectroscopy; Nashville, Tennessee, United States of America (USA) (11 Aug 1969). See CONF-690818-(Vol. 2).

26357 RESULTS OF $\alpha\,\gamma$ COINCIDENCES IN ^{241}Am α-DECAY. Kamoun, R.; Ballini, R. (CEN, Saclay, France). pp 1291-1294 of Radioactivity in Nuclear Spectroscopy. Vol. II. Hamilton, J. H. (Ed.). New York; Grodon and Breach Publishers, Inc. (1972).

From International Conference on Radioactivity in Nuclear Spectroscopy; Nashville, Tennessee, United States of America (USA) (11 Aug 1969). See CONF-690818-(Vol. 2).

26358 LEVELS IN ^{240}Pu POPULATED IN THE DECAY OF ^{240}Np AND IN THE ALPHA DECAY OF ^{244}Cm. Zender, M. J.; Bemis, C. E. Jr.; Schmorak, M. R. (Oak Ridge National Lab., TN). pp 1295-1299 of Radioactivity in Nuclear Spectroscopy. Vol. II. Hamilton, J. H. (Ed.). New York; Gordon and Breach Publishers, Inc. (1972).

From International Conference on Radioactivity in Nuclear Spectroscopy; Nashville, Tennessee, United States of America (USA) (11 Aug 1969). See CONF-690818-(Vol. 2).

26359 M AND N SUBSHELL RATIOS OF THE 43.5 keV, E2 TRANSITION IN ^{234}U. Hamilton, J. H. (Vanderbilt Univ., Nashville); LaCasse, W. M.; Geiger, J. S.; Graham, R. L.; Amtey, S. R. pp 1369-1373 of Radioactivity in Nuclear Spectroscopy. Vol. II. Hamilton, J. H. (Ed.). New York; Gordon and Breach Publishers, Inc. (1972).

From International Conference on Radioactivity in Nuclear Spectroscopy; Nashville, Tennessee, United States of America (USA) (11 Aug 1969). See CONF-690818-(Vol. 2).

26360 SOME NUCLEAR PROPERTIES OF ^{257}Fm. Wild, J. F.; Hulet, E. K.; Lougheed, R. W. J. Inorg. Nucl. Chem.; 35: No. 4, 1063-1067(Apr 1973).

A total half-life of 100.5 ± 0.2 days and an alpha-to-spontaneous-fission decay ratio of 475 ± 10 have been measured for ^{257}Fm by counting in ionization chambers. Thermal-neutron fission cross sections for ^{257}Fm (2950 ± 160 b) and its daughter, ^{253}Cf (1300 ± 240 b), have been measured in a thermal-neutron column using mica as a fission-fragment track recorder. (auth)

26361 EXPLORATIONS FAR FROM STABILITY. Keller, O. L. (Oak Ridge National Lab., TN). Comments Nucl. Particle Phys.; 5: No. 4, 95-99(Jul 1972).

It is stated that from the point of view of scientific importance studies in the area far from the line of β stability are of great interest, since phenomena can be studied there that cannot be studied anywhere else. The field is ripe for development both from the experimental and theoretical points of view. The importance of studying nuclei along the N = Z line, only possible far from stability, except for the lightest nuclei, is pointed out; and a maximum opportunity is provided for the study of neutron–proton correlation effects. A number of phenomena, including β decay and deformation effects, should be better studied along the N = Z line than near stability. An important question involves the validity far from stability of the currently accepted mass formulas. Work on α-emitters far from the line of stability with atomic numbers from 67 to 76, such as ^{156}Yb, ^{159}Hf and ^{169}Os, is mentioned, also predictions of stability for the superheavy elements. With regard to the latter they are predicted to occur around Z = 144 and N = 184. Ways in which nuclei far from stability are to be produced are discussed, including spallation reactions from high-energy protons using accelerators. Heavy-ion accelerators are thought to represent the only reasonable way to reach the superheavy island of stability, and on-line mass separation is a necessity. The study of nuclei far from stability and, particularly, production of the superheavy elements will almost require new understandings of the mechanisms of heavy-ion reactions. Reference is also made to the prediction of a "double-humped" fission barrier in the actinide region. Fission isomers are thought to be nuclear matter in a new shape. Another area that will benefit greatly from studies far from stability is nucleosynthesis. (UK)

26362 INTERMEDIATE STRUCTURE IN THE FISSION CROSS SECTION OF ^{237}Np. Plattard, S.; Michaudon, A.; Paya, D. (CEN de Saclay, Gif-sur-Yvette, France). J. Phys. (Paris), Colloq.; No. 5, 21(1972). (In French).

Time-of-flight method experiments with neutrons enabled the existence of an intermediate structure in the fission cross section of ^{237}Np to be determined beneath the threshold. This effect is explained by the presence of intermediate states (class II states) in the 2nd well of a double-humped fission barrier. The fission cross section of ^{237}Np was remeasured with a better resolution, the sample being cooled to 77°K. (FR)

26363 CUMULATIVE YIELDS OF THE HEAVY FRAGMENTS IN THE FAST NEUTRON FISSION OF ^{238}U. Mathews, C. K.; Tomlinson, R. H. (McMaster Univ., Hamilton, Ont.). Can. J. Phys.; 50: No. 24, 3100-3110(15 Dec 1972).

Isotopic abundances of the elements xenon, cesium, barium, cerium, neodymium, and samarium formed in the fast (fission spectrum) neutron fission of ^{238}U were measured using the mass spectrometric method. These ratios were normalized with respect to each other through isobaric nuclides and isotope dilution to obtain the relative yields of isobaric chains in the heavy mass region. By normalizing the heavy mass yields to 100%, the absolute fission

yields of 20 chains in the 130–154 mass range were determined. (auth)

26364 MASS DISTRIBUTION OF FISSION FRAGMENTS FROM $^{235}U(n_{th},f)$ BY SIMULTANEOUS MEASUREMENTS OF VELOCITY AND ENERGY. Shiraishi, F.; Hosoe, M. (Rikkyo Univ., Nagasaka) Nucl. Instrum. Methods; 107: No. 3, 493-500(1973).

A method for measuring the post-neutron-emission mass distribution of fission fragments from $^{235}U(n_{th},f)$ reactions by thermal neutrons in a reactor has been given. In the experiment two silicon solid state detectors were used to determine the energy and the flight time of the fragments, and an analog pulse computing circuit was used to calculate the mass values. In the present article the flight time, velocity, energy, and mass distributions measured by this method are analyzed; and their characteristic figures, the mean values, and the rms widths of the distributions for the individual group of the light (70 to 117 amu) and heavy (118 to 160 amu) fragments, are calculated and shown. The velocity distribution for fragments was obtained with an accuracy of the time resolution of 0.2 ns rms width. (6 figures, 4 tables) (auth)

Nuclear Theory

Refer also to abstracts 25806, 25829, 25925, 25934, 25997, 26075, 26087, 26091, 26138, 26255, and 26336.

26365 (AD-743244) NUCLEAR REACTION THEORY. FINAL TECHNICAL LETTER REPORT, 1 FEBRUARY 1970–1 DECEMBER 1971. Pearson, C. A. (Alabama Univ., Birmingham (USA)). May 1972. Contract DAAH01-70-C-0785. 13p. NTIS.

The calculations for the WBP model for (d,p) reactions were refined to include contributions from the deuteron D-state, nonlocal nucleon–nucleus optical-model potentials, a finite-range neutron–proton interaction V_{np}, and a realistic (Hamada–Johnston) deuteron wave function. With these refinements the model was tested as a tool for analyzing stripping reaction measurements. It was shown to reproduce the angular dependence of the measured vector analyzing power, polarization, and differential cross sections for (d,p) and (d,n) reactions in which the final state is known to be predominantly a $2s_{\frac{1}{2}}$, $3s_{\frac{1}{2}}$, $1p_{\frac{1}{2}}$, $2p_{\frac{1}{2}}$, $2p_{\frac{3}{2}}$, $1d_{\frac{3}{2}}$, $2d_{\frac{3}{2}}$, or $1f_{\frac{7}{2}}$ shell-model state. Spectroscopic factors were also extracted. Their values were independent of the deuteron energy and were compatible with results from nuclear-structure calculations. The errors in these values due to ambiguities in the optical potential parameters were typically ≤15%. (auth)

26366 (CONF-720404-(Vol. 3), pp 1957-1964) EXCHANGE-OVERLAP CALCULATIONS IN ORBITAL ELECTRON CAPTURE. Vatai, F. (Inst. of Nuclear Research, Debrecen, Hungary). Jan 1973.

From International conference on inner shell ionization phenomena and future applications; Atlanta, Georgia, USA (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

A review of the theory and a comparison of the results of different calculations of exchange and overlap correction in electron capture are given. (auth)

26367 (CONF-720404-(Vol. 3), pp 2050-2078) RECENT DEVELOPMENTS OF THE STUDY ON THE K-SHELL INTERNAL IONIZATION IN BETA DECAY. Shimizu, S. (Kyoto Univ.). Jan 1973.

From International conference on inner shell ionization phenomena and future applications; Atlanta, Georgia, USA (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

Recent experiments to study the phenomenon by measuring the energy-dependent ionization probability $P_K(E_\beta^0)$ as a function of E_β^0, where the parameter E_β^0 is defined as a sum of energies of β particle, E_β, and emitted K electron, E_K, plus K-shell binding energy of the daughter atom, B_K are reviewed. The one-step theory of the electron shake off developed by Stephas and Crasemann has been improved by using the energy-dependent antisymmetrization factor $\Xi(E_\beta,E_K)$ and the exact relativistic hydrogenic atomic matrix element. It has been found that the experimental $P_K(E_\beta^0)$ deviates considerably from that predicted by this improved theory, suggesting that the direct collision process may play an important role in the low energy region of E_β^0. As to the total ionization probability, the improved theory can give the values in fairly good agreement with the measured values. (auth)

26368 (CONF-720404-(Vol. 3), pp 2079-2109) INTERNAL IONIZATION OF THE K SHELL ACCOMPANYING BETA DECAY. Mord, A. J. (Univ. of Oregon, Eugene). Jan 1973.

From International conference on inner shell ionization phenomena and future applications; Atlanta, Georgia, USA (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

The basis of the shakeoff theory is briefly reviewed. The effect of the indistinguishability of the two outgoing electrons is investigated in allowed and first-forbidden unique beta decay. Three definitions of total probability P_K in current use are compared and discussed. An exact relativistic hydrogenic atomic matrix element is used in predicting P_K for fourteen isotopes and spectra for two isotopes. The role of the shape factor is clearly seen in the spectrum predicted for first-forbidden unique decay. (auth)

26369 (CONF-720404-(Vol. 3), pp 2110-2140) NEW MODEL FOR AUTO-IONIZATION IN BETA DECAY. Law, J.; Campbell, J. L. (Univ. of Guelph, Ont.). Jan 1973.

From International conference on inner shell ionization phenomena and future applications; Atlanta, Georgia, USA (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

A new one-step model is presented for the higher order process of auto-ionization in beta decay. Explicit account is taken of the indistinguishability of the two continuum negatons in β^--decay, but the effect of anti-symmetrization between these and the remaining bound negatons is not taken into account. Relativistic hydrogenic wave functions are used and Coulomb corrections and shape factors included. A critical review of experimental data for the K and L shells and β^--decay is given. Comparison of the theoretcial predictions with recent measurements of total shake-off probability P_K and of negaton spectra coincident with K vacancies is encouraging, but indicates a need for new experimental work. Experiments on β^+-decay are suggested, since the theory predicts large differences for P_K in β^+- and β^--decays at the same mass number. (auth)

26370 (COO-1051-61) FINAL TECHNICAL PROGRESS REPORT, JUNE 1–DECEMBER 1971. (Michigan State Univ., East Lansing). 1972. Contract AT(11-1)-1051. 5p. Dep. NTIS $3.00.

Research on nuclear reaction theory is summarized. A list of publications is included. (JFP)

26371 (COO-3496-10) COMPUTER PROGRAMS FOR STATISTICAL NUCLEAR DECAY. Lu, C. C.; Vaz, L. C.; Huizenga, J. R. (Rochester Univ., N. Y. Nuclear Structure Research Lab.). Apr 1972. 101p. (UR-NSRL-51). Dep. NTIS $7.25.

Computer programs which generate energy spectra and angular distributions of protons, neutrons, deuterons, and alpha particles evaporated from a compound nucleus are described. The subsequent decay of these levels with different angular momentum (incorporated explicitly) populates many levels in the available residual nuclei. In addition, calculations are described which include isospin as an additional quantum number (program MACT 3). Program EVAP generates angle-integrated differential cross sections with no limits imposed on the summation over the spin of the residual nucleus. Program descriptions accompany each program. Included in each description are the limitations imposed on the various sums involved in the computations. Calculations can be done by including the Legendre polynomials of the even order (L) up to 10 (MAC10). However, for many cases of interest, accurate results are obtained by expanding the Legendre polynomials up to L = 6 (MAC3, YRAST, MACT3). Calculations can be performed with either the Fermi gas model or the constant temperature model for the level density. Program YRAST uses the yrast form for the level density. Z coefficients required in the calculations are computed for both integral and half-integral channel spins by the computer code ZCOEF. The programs are written in FORTRAN IV for the IBM 360/65. (RWR)

26372 (COO-3496-11) STATISTICAL PROGRAM GAMAJ. Vaz, L. C.; Lu, C. C.; Huizenga, J. R. (Rochester Univ., N. Y. Nuclear Structure Research Lab.). May 1972. 28p. (UR-NSRL-54). Dep. NTIS $3.50.

This program calculates the cross section for formation and the spin distribution of the compound nucleus formed in the nuclear reaction A + a → C* → B + b, as well as the total width, Γ, and partial widths, Γ^b, for the decay by alpha particles, protons, neutrons, and deuterons. The theoretical expressions on which the program is based are discussed. The program is coded in FORTRAN. (RWR)

26373 (ITF-72-150-E) INHOMOGENEITY OF NUCLEON DISTRIBUTIONS IN HEAVY NUCLEI. Antonchenko, V. Ya.; Simenog, I. V. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1972. 24p. Dep. NTIS (U.S. Sales Only) $3.25.

The equations for a self-consistent nucleon field in nuclei with a large number of particles are studied. An iterative solution scheme for nonlinear equations is proposed, and the neutron and proton density distributions for some variants of pair nucleon–nucleon potentials are obtained. It is shown that the resulting inhomogeneity of nucleon distribution in nuclear volume depends on the choice of pair interaction. (13 figures, 3 tables) (auth)

26374 (JINR-P4-6898) TEST OF DISCRETE SYMMETRIES IN NUCLEAR REACTIONS INDUCED BY ELECTRONS AND PHOTONS. Dubovik, V. M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 22p. (In Russian). (CONF-721215-1). Dep. NTIS (U.S. Sales Only) $3.25.

From Seminar on electromagnetic interactions of nuclei at small and medium energies; Moscow (Dec 1972).

The problems are discussed, concerning the test of discrete symmetries (mainly T). The experimental and theoretical materials for 1969 to 1972 have been used. The general attention is paid to the situation on the photoproduction and the searches for the electric dipole moment of a neutron and the toroid quadrupole moment of a deuteron. (auth)

26375 (JINR-P4-6916) METHOD FOR THE CALCULATION OF STRIPPING FORM FACTORS FOR THE CCBA. Bang, E.; Gareev, F. A.; Shul'ts, G.; Yamaleev, R. M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 30p. (In Russian). Dep. NTIS (U.S. Sales Only) $3.50.

A method for the calculation of form factors for stripping reactions on nuclei having vibrational-like states is presented. In the final-state wave function the interaction of the transferred neutron with the collective motion of the target nucleus is taken into account in a phenomenological manner. In order to expand the final-state function in terms of the target wave function plus single-particle wave function the Sturmian functions are employed. The form factors obtained are used in DWBA and CCBA calculations. (auth) (3 figures, 2 tables)

26376 (LA-5047) NUCLEAR WAVE FUNCTIONS FROM PARTICLE TRANSFER DATA. Kisslinger, L. S. (Los Alamos Scientific Lab., N. Mex.). Jan 1973. Contract W-7405-eng-36. 7p. Dep. NTIS $3.00.

By using the analytic properties of scattering amplitudes in the cos θ plane, along with the conformal mapping technique to improve the convergence, nuclear properties are extracted directly from reaction data. At low energies one obtains spectroscopic factors—the amplitude of the asymptotic part of the wave function for a particular channel. At high energies short-range aspects of the wave functions are studied by including form factors at the vertices. (5 figures) (auth)

26377 (LA-5196-MS) SCATTERING FORMULAS FOR THE TWO PARTICLE REACTION. Everett, C. J.; Cashwell, E. D. (Los Alamos Scientific Lab., N. Mex.). Feb 1973. Contract W-7405-eng-36. 7p. Dep. NTIS $3.00.

After a general (nonrelativistic) treatment of transmutation resulting in two particles, the formulas obtained are specialized to give the laboratory energy-angle dependence for the inelastic (n,n')-reaction and the elastic (n,n)-collision, in a form adapted to computation. These results are required for Monte Carlo neutron codes when the differential cross sections for such reactions are given in the laboratory frame, and in any case, for the "point detector" routine. (auth)

26378 (ORNL-tr-2653) CALCULATION OF NUCLEAR BOUNDARY DIFFUSION BY THE MODEL OF INTRANUCLEAR CASCADES. Barashenkov, V. S.; Gudima, K. K.; Zheregi, F. G.; Toneev, V. D. (Joint Inst. for Nuclear Research, Dubna (USSR)). Translated from Report JINR-P2-6503. 1972. 7p. Dep. NTIS $3.00.

Taking into account the nuclear potential diffusivity and the density distribution of nuclear constituents in Monte Carlo calculations is considered. This method does not use the division of the nucleus into spherical zones with constant density. The method developed corresponds to a more realistic nuclear model and, at the same time, simplifies essentially the intranuclear cascade calculations, especially in the case of interactions of high-energy ions with nuclei. (2 figures, 2 tables) (auth)

26379 INFLUENCE OF SCREENING ON THE FORM OF POSITRON SPECTRA OF PAIR CONVERSION. Eglais, M. O. (Latvian State Univ., Riga). Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 10, 2184-2185(Oct 1972). (In Russian).

The positron spectra from E1 transitions were calculated, allowing for and not allowing screening. Results were obtained for Z = 84, k = 2.5 and 10 mc^2, and for Z = 50, k = 3 mc^2. Positron spectra at the upper threshold are discussed. (1 table) (tr-auth)

26380 CALCULATION OF DIFFERENTIAL AND TOTAL COEFFICIENTS OF PAIR CONVERSION FOR TRANSITION ENERGIES OF UP TO 10 MeV. Belyaev, B. N. Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 10, 2196-2202(Oct 1972). (In Russian).

The results of calculations of the differential and total coefficients of pair conversion for E1, M1, E2, and M2 multipole orders are summarized for various transition energies (to 10 MeV) and for different nuclear charges. Solutions of the Dirac equation with the potential $\alpha Z/r$ were selected as wave functions of the electron and positron. (2 figures, 1 table) (tr-auth)

26381 MONOPOLE ISOVECTOR STATES AND CONSERVATION OF ISOTOPIC SPIN IN GROUND STATES OF EVEN–EVEN NUCLEI. Mikhailov, V. M.; Solov'ev, V. N. (Leningrad State Univ.). Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 10, 2179-2183 (Oct 1972). (In Russian).

The role of collective monopole isovector excitations in the violation of isospin purity was examined. Energy estimates for these states and their admixtures with the ground state of even–even nuclei are presented within the framework of a schematic model. (1 table) (tr-auth)

26382 MULTIPLET SPLITTING OF SOME THREE-PARTICLE CONFIGURATIONS OF THE TYPE $([j_1j_2]I'_{max}; j_3)$. Guman, V. N.; Peker, L. K.; Kharitonov, Yu. I. Izv. Akad. Nauk SSSR, Ser. Fiz.; 36: No. 10, 2245-2248(Oct 1972). (In Russian).

An investigation of the peculiarities of splitting of multiplets of three-particle configurations stems from the rapid accumulation of experimental data on the properties of highly excited levels. This article deals with proton–neutron configurations of the type $\{[j_1j_2]I_{max}; j_3\}$, $j_1 \neq j_2$, since they are often important to the existence of three-particle isomeric states. Theoretical and experimental energy values and spectroscopic factors of the levels of ^{139}La relative to the configuration $\{[p(g_{\frac{7}{2}})^{-1}\, n(d_{\frac{5}{2}})^1]I^{\pi}_{max}= 5^+;\ n(f_{\frac{7}{2}})^1\}$ are tabulated. (3 figures, 2 tables) (KSW)

26383 SEQUENTIAL REACTION PROCESSES IN NUCLEAR FISSION. Izumo, K. (Nihon Univ., Tokyo). J. Phys. (Paris), Colloq.; No. 5, 10(1972).

The nuclear fission reaction mechanism was studied using an original time-dependent treatment in which the wave function of the compound nucleus is expanded in sequential series representing the reaction process. The deformed nucleus (1st stage) undergoes a phase transition in which the compound nucleus (2nd stage) separates into two inert cores and excited nucleons. Finally, the nucleus splits into two fragments. (FR)

26384 S-MATRIX FORMULATION, DYNAMICS, AND MODELS OF THE FISSION PROCESS. Noerenberg, W. (Univ., Heidelberg). J. Phys. (Paris), Colloq.; No. 5, 16(1972).

An S-matrix formulation of the induced fission $T + P \rightarrow C' \rightarrow F_1 + F_2$ is presented by introducing scattering states of the target, T, and projectile, P, bound states of the compound system, C, and fissioning states of the F_1 and F_2 fragment pair. (FR)

26385 MICROSCOPIC THEORY FOR THE ELASTIC INTERACTION OF COMPLEX NUCLEI. Pruesz, K. (Univ., Frankfurt am Main). J. Phys. (Paris), Colloq.; No. 5, 46(1972).

The elastic interaction between complex nuclei can be successfully described using local optical potentials. Microscopic calculations of these potentials—at least their real parts—using either the two-center shell model or two-center states generated from one-center shell model were developed. (FR)

26386 PREDICTIONS FOR HEAVY ION REACTIONS BASED ON THE ROTATING LIQUID DROP MODEL. Plasil, Franz (Oak Ridge National Lab., TN). J. Phys. (Paris), Colloq.; No. 5, 51 (1972).

Angular momentum values beyond which nuclei cease to be stable are given as a function of the fissibility parameter. The ratio of the complete fusion cross section to the total cross section is also given for a number of 10.5-MeV per nucleon projectiles as a function of the resulting compound-nucleus mass. (FR)

26387 LOW ENERGY PIONS IN NUCLEAR PHYSICS. Rho, M. (CEN de Saclay, Gif-sur-Yvette, France). J. Phys. (Paris), Colloq.; No. 5, C5.155-C5.169(1972).

The effect of virtual pions of the low-energy properties of nuclei and the interaction between nuclei and low-energy real pions are discussed in terms of the soft-pion theorem. The following subjects are considered: exchange current phenomena; sum rules

connecting these phenomena to quantities measurable in high-energy experiments; production; absorption and scattering of pions near the threshold; extraction of information concerning the breaking of chiral symmetry in strong interactions. (FR)

26388 QUASI-FREE SCATTERING ON NUCLEONS AND NUCLEAR FRAGMENTS. Radvanyi, P. (Paris Univ., Orsay, France). J. Phys. (Paris), Colloq.; No. 5, C5.141-C5.154(1972).

Recent results in the study of quasi-free scattering on nucleons and on nuclear clusters inside nuclei are discussed. The kinematic conditions for these reactions (treated in the framework of the impulse approximation) are surveyed. The most recent (p,2p) experiments at 600 MeV and (e,e'p) experiments at 500 MeV are analyzed, particular attention being given to the knock-out of protons from the 1s shell and various other shells. The results obtained on the quasi-free scattering on nucleon clusters inside nuclei are discussed and compared with predictions. (FR)

26389 FISSION, FUSION, AND HEAVY ION SCATTERING IN THE LIQUID DROP MODEL. Hasse, R. W. (Univ., Heidelberg). J. Phys. (Paris), Colloq.; No. 5, 14(1972).

The polarization of the fragments from binary fission or of fusioning or scattering nuclei was investigated in the framework of the liquid-drop model. (FR)

26390 HEAVY IONS SCATTERING AT LOW ENERGY IN THE FRAMEWORK OF MOLECULAR ORBITALS. Becker, F.; Beccaria, C. (Centre National de la Recherche Scientifique, Strasbourg). J. Phys. (Paris), Colloq.; No. 5, 44(1972).

Nuclei are described in terms of a core and one peripheral nucleon (or cluster). Nucleon-exchange effects between two clusters are neglected, and the wave function describing the elastic scattering and the transfer reaction is expressed as a linear combination of molecular orbitals. (FR)

26391 RECOIL EFFECTS IN DWBA CALCULATIONS FOR HEAVY-ION REACTIONS. DeVries, R. M. (CEN de Saclay, Gif-sur-Yvette, France). J. Phys. (Paris), Colloq.; No. 5, 61 (1972).

An exact finite-range DWBA code using a formalism which includes exact effects was written for heavy-ion transfer reactions. (FR)

26392 EXPERIMENTAL EVIDENCES FOR PHASE TRANSITIONS IN ATOMIC NUCLEI. Johnson, A.; Ryde, H.; Hjorth, S. A.; Barneoud, D. (Research Inst. for Physics, Stockholm). J. Phys. (Paris), Colloq.; No. 5, 109(1972).

Studies of ground-state rotational bands in doubly even nuclides using (H.I.,xn) reactions revealed that the moment of inertia increases with increasing spin and that this growth can sometimes be extremely rapid. These rapid changes in the moment of inertia are interpreted as being due to a phase transition, due to the Coriolis anti-pairing effect, from a pair-correlated or superfluid state to a normal state without pair correlations. (FR)

26393 π–NUCLEUS SCATTERING AND VIOLATION OF THE CHIRAL SYMMETRY. Ericson, M. (Univ., Lyon); Rho, M. J. Phys. (Paris), Colloq.; No. 5, 142(1972).

The pion elastic scattering amplitude was studied in the framework of strong interaction symmetry. (FR)

26394 HIGH-ENERGY ELASTIC SCATTERING OF PROTONS BY NUCLEI. Lambert, E.; Feshbach, H. (Massachusetts Inst. of Tech., Cambridge). J. Phys. (Paris), Colloq.; No. 5, 145 (1972).

The two-coupled-channel formalism for high-energy elastic scattering is extended to include spin and isospin effects. Numerical calculations are performed for the elastic scattering of 1-GeV protons incident on ^{4}He. (FR)

26395 NUCLEON DISTRIBUTIONS IN NUCLEI FROM HIGH-ENERGY PROCESSES. Lombard, R. J. (Paris Univ., Orsay, France); Auger, J. P. J. Phys. (Paris), Colloq.; No. 5, 156(1972).

Two types of nuclear density distributions are considered: a distribution derived from the Brueckner formalism for the energy density using the Thomas–Fermi approximation for the kinetic energy of the nucleons; a distribution derived from a shell-model calculation in which the average field is in the form of a generalized semi-self-consistent Beiner potential. (FR)

26396 NUCLEAR STRUCTURE WITH HEAVY-ION TRANSFER REACTIONS. Morrison, G. C. (Argonne National Lab., IL). J. Phys. (Paris), Colloq.; No. 5, C5.111-C5.126(1972).

At the present time, the study of nuclear structure with heavy-ion transfer reactions is the focus of increased attention, both experimental and theoretical. The general features encountered in the majority of such reactions are surveyed in terms of the well-known semi-classical description. This is followed by a description of current DWBA approaches and their use to extract quantitative spectroscopic information from single- and multi-nucleon transfer reactions. Finally, the striking selectivity in excited levels and other features revealed in recent experimental results at high energies are discussed. (FR)

26397 NUCLEUS OF THE FUTURE. Wilkinson, D. H. (Oxford Univ.). J. Phys. (Paris), Colloq.; No. 5, C5.207-C5.210(1972).

Possible modifications to existing theories concerning interactions within the nucleus are envisaged. (FR)

26398 SHELL EFFECTS IN FISSION PROCESSES. Balian, R. (CEN de Saclay, Gif-sur-Yvette, France). J. Phys. (Paris), Colloq.; No. 5, C5.17-C5.32(1972). (In French).

A brief review is given of experiments which cannot be explained by the liquid drop model. Theoretical calculations of fission barriers are described. These calculations interpret the experiments in terms of shell effects occurring with highly deformed fissioning nuclei. An attempt is made to explain the generality of shell effects and to calculate these effects directly. The principal concepts of a new method which does not necessitate the solution of the 3-dimensional independent particle–wave interaction are presented; shell corrections to the level density are analyzed in terms of a sequence of oscillating terms, each term being associated with a closed classical path (possibly complex). A numerical test demonstrated the efficiency of this method, which is applicable even when the spectrum presents a continuum. (FR)

26399 RANK-ONE SEPARABLE POTENTIALS FROM NUCLEON–NUCLEON PHASE SHIFTS. Schaposnik, F. A.; de Vega, H. J. (Univ. Nacional, La Plata). Nuovo Cim.; 13A: No. 4, 923-936(21 Feb 1973).

A set of rank-one separable potentials is presented for the nucleon–nucleon system corresponding to all partial waves up to L = 2. The form factors of these interactions were obtained by using the solution of the inverse problem and by fitting their parameters to represent the Arndt–MacGregor–Wright nucleon–nucleon phase shifts. The resulting potentials in computing two- and three-nucleon parameters were also studied. (auth)

26400 REVIEW OF THEORETICAL CONVERSION COEFFICIENTS AND PENETRATION EFFECTS. Pauli, H. C. (Niels Bohr Inst., Copenhagen). pp 715-745 of Radioactivity in Nuclear Spectroscopy. Vol. II. Hamilton, J. H. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From International Conference on Radioactivity in Nuclear Spectroscopy; Nashville, Tennessee, United States of America (USA) (11 Aug 1969). See CONF-690818-(Vol.2).

The assumptions that necessarily enter into internal conversion calculations are discussed first; these include the point-nucleus model, the finite nuclear size, and the screening of the atomic electrons. The interrelations between available internal conversion calculations are next taken up; exact calculations, approximation methods, and the comparison of various recent calculations are considered. In more refined analyses of the internal conversion process, it becomes clear that the rate of conversion is not strictly proportional to the reduced nuclear transition probability, but that there exist nuclear transition modes, peculiar and specific to the internal conversion process. In most cases, however, the additional internal conversion rate is too small to show measurable effects. If, on the other hand, the usual de-excitation process is hindered, they may become very important, and there are cases in which the whole conversion rate is fed by these so-called penetration effects. After some general remarks, the nuclear matrix elements are defined for the electric multipole, magnetic multipole transitions, and electric monopole transitions; in conclusion, penetration in electric dipole transitions is discussed. (10 figures, 3 tables, 42 references) (RWR)

26401 APPROXIMATE INTERNAL CONVERSION COEFFICIENTS FOR OUTER SHELL ELECTRONS. Dragoun, O.; (Max-Planck-Inst. fuer Kernphysik, Heidelberg); Plajner, Z.; Schmutzler, F. pp 747-751 of Radioactivity in Nuclear Spectroscopy. Vol. II. Hamilton, J. H. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From International Conference on Radioactivity in Nuclear Spectroscopy; Nashville, Tennessee, United States of America (USA) (11 Aug 1969). See CONF-690818-(Vol.2).

The calculation of approximate internal conversion coefficients for outer-shell electrons published elsewhere is briefly described. It is to be noted that the values given in the Max-Planck-Inst. fuer Kernphysik Report MPIH-1969-V5 correspond to fully occupied subshells. In order to get the analytic estimate for partially occupied subshells, an additional correction factor for the fraction of total occupancy must be applied. (1 table) (RWR)

26402 INFLUENCE OF THE VALENCE SHELL STRUCTURE ON THE INTERNAL CONVERSION COEFFICIENTS AND ON THE ELECTRON DENSITY IN THE NUCLEAR REGION. Anderson, E. M.; Khanonkind, M. A.; Listengarten, M. A. (Inst. for Physics, Leningrad). pp 897-900 of Radioactivity in Nuclear Spectroscopy. Vol. II. Hamilton, J. H. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From International Conference on Radioactivity in Nuclear Spectroscopy; Nashville, Tennessee, United States of America (USA) (11 Aug 1969). See CONF-690818-(Vol.2).

The connection of the valence shell structure with the internal conversion coefficients (ICC) and $|\Psi(0)|^2$ was investigated for an atom, viz., Sn, from which one 5p electron is removed. The M1, M2, E1, and E2 ICC for K, L_I, L_{II}, L_{III}, O_I, and O_{II} shells were calculated for a neutral atom, ^{119}Sn I, and for a free ion, ^{119}Sn II. A modified Hartree—Fock (HF) method was used in which the exchange term of the self-consistent HF field was replaced by the potential energy statistical function. The principal result was that the proportionality (within 5%) of the theoretical ICC (for the outer valence shells, low-energy transitions, and low multipoles) during a change of the valence shell structure was verified for the example used. This precision is obtained only when the ICC and $|\Psi(0)|^2$ are calculated by the same method, in particular, using relativistic self-consistent-field wave functions with finite-size corrections. (RWR)

26403 TIME-DEPENDENT HYPERFINE INTERACTIONS. Gelberg, A. (Inst. for Atomic Physics, Bucharest). pp 1053-1085 of Radioactivity in Nuclear Spectroscopy. Vol. II. Hamilton, J. H. (ed.). New York; Gordon and Breach, Science Publishers, Inc. (1972).

From International Conference on Radioactivity in Nuclear Spectroscopy; Nashville, Tennessee, United States of America (USA) (11 Aug 1969). See CONF-690818-(Vol.2).

Some basic elements regarding relaxation mechanisms are briefly recalled in the introduction. Then an outline of the general theory of emission and absorption of gamma rays in the presence of a time-dependent hyperfine interaction is given. Relaxation phenomena in the Moessbauer effect are treated in some detail. Then relaxation phenomena in angular correlations are examined. Finally, transient fields due to nonequilibrium electronic configurations are briefly discussed. (13 figures) (RWR)

26404 COMPARISONS OF STRUCTURE EFFECTS IN L AND M SUBSHELL RATIOS. Amtey, S. R.; Hamilton, J. H. (Vanderbilt Univ., Nashville). pp 1343-1348 of Radioactivity in Nuclear Spectroscopy. Vol. II. Hamilton, J. H. (ed.). New York; Gordon and Breach Publishers, Inc. (1972).

From International Conference on Radioactivity in Nuclear Spectroscopy; Nashville, Tennessee, United States of America (USA) (11 Aug 1969). See CONF-690818-(Vol.2).

26405 PENETRATION EFFECTS IN K-CONVERSION COEFFICIENTS FOR 1-FORBIDDEN M1-TRANSITIONS. Vanden Berghe, G.; Heyde, K. (Rijksuniversiteit, Ghent). pp 1411-1418 of Radioactivity in Nuclear Spectroscopy. Vol. II. Hamilton, J. H. (ed.). New York; Gordon and Breach Publishers, Inc. (1972).

From International Conference on Radioactivity in Nuclear Spectroscopy; Nashville, Tennessee, United States of America (USA) (11 Aug 1969). See CONF-690818-(Vol.2).

26406 ELECTRON SPIN DENSITY AND INTERNAL CONVERSION PROCESS. Morita, M.; Sugimato, K.; Yamada, M.; Yokoo, Y. (Osaka Univ.). pp 1419-1421 of Radioactivity in Nuclear Spectroscopy. Vol. II. Hamilton, J. H. (ed.). New York; Gordon and Breach Publishers, Inc. (1972).

From International Conference on Radioactivity in Nuclear Spectroscopy; Nashville, Tennessee, United States of America (USA) (11 Aug 1969). See CONF-690818-(Vol.2).

26407 GREEN'S FUNCTIONS IN THE THEORY OF NUCLEAR MATTER. Weigel, M. (Univ. of California, Berkeley); Wegmann, G. Fortschr. Phys.; 19: No. 7, 451-489(1971). (In German).

The aim of this article is the representation of the theory of nuclear matter with the technique of many-body Green functions. The theory of Green functions is treated thoroughly in the first chapters taking support of the functional method, which offers a convenient approach to the construction of the theory. After treatment of the properties of the exact two-point function and of the effective single-particle potential, preconditions and properties of the approximate solutions are discussed. Results achieved to date are treated in chapter 6. Brueckner theory and allied methods are not further discussed, since these are sufficiently known. The theory of linear response, being important for the semi-phenomenological treatment of real atomic nuclei, is presented in appendix A. (auth)

26408 PROGRAMS FOR INTERPRETATION OF SPECTRA OF INELASTICALLY SCATTERED FAST NEUTRONS WITHIN THE SCOPE OF STATISTICAL NUCLEAR MODEL. Giera, H. D.; Seeliger, D.; Seidel, K.; Wohlfarth, D. (Technische Univ., Dresden). Kernenergie; 15: No. 11-12, 384-391(1972). (In German).

The ALGOL program NONEQUI serves to analyze the mechanism of inelastic scattering. With a χ^2 fit the experimentally obtained spectra are described as the sum of emission spectra from the compound nucleus, i.e., from the statistical equilibrium state, and nonequilibrium emission spectra which are calculated by means of Griffin and Blann's exciton model. In the ALGOL program TEMP the Weisskopf—Ewing formula is employed to extract level density parameters and nuclear temperatures in a narrow range of spectrum whose slope is determined by compound nucleus emission only. The problems and conditions appearing in application of these formalisms to the interpretation of inelastic scattering are discussed by several examples. (7 figures, 1 table) (auth)

26409 MICROSCOPIC APPROACH TO CALCULATIONS OF NUCLEAR FISSION PROBABILITY. Dudek, J. (Univ., Warsaw). Nucl. Phys.; A203: No. 1, 121-132(1973).

A new parameterization of the double-humped barrier containing a nonvanishing imaginary part is introduced. The real part of the potential was fitted to the barrier calculated according to the Strutinski method. These calculations were based on the four-dimensional (ϵ_2, ϵ_3, ϵ_4, ϵ_5) Nilsson scheme. The effect of the deformation-dependent mass parameter on the probability of fission was taken partially into account. The ^{241}Pu(d,pf) process was studied theoretically, and the results are compared with the experimental data. (3 figures, 2 tables) (auth)

26410 CORRELATIONS AND THE PION-NUCLEUS OPTICAL POTENTIAL. Faeldt, Goeran (Schweizerisches Institut fuer Nuklearforschung, Zurich). Nucl. Phys.; A202: No. 2, 403-408 (1973).

The influence of nucleon—nucleon correlations on the parameters of the pion—nucleus optical potential are investigated. In the (3,3) resonance region the corrections can be as large as 30%, and their nature is intermediate between well-known high- and low-energy limits. Binding and correlation effects add constructively below the resonance and destructively above. (1 table) (auth)

26411 COLLECTIVE NUCLEAR MODEL AND QUASI-PARTICLE EXCITATIONS. Weller, F. (Kernforschungszentrum, Karlsruhe, Ger.). Fortschr. Phys.; 19: No. 5, 201-299(1971). (In German).

A method is described which extends the usual Coriolis-coupling band-mixing calculations by the inclusion of rotation—vibration interaction and quasi-particle—phonon interaction. It is based on Bohr's collective Hamiltonian and on the rotation—vibration interaction model of Faessler and Greiner. These collective models are described in detail. The success of the method depends on a careful treatment of the pairing correlations, which have a striking influence. The reason is that the operators of the quasi-particle—phonon interaction commute with the time-reversal operator, so that their matrix elements between single-particle states are in many cases considerably reduced by the pairing correlations. Because this interaction mixes high-lying configurations with low-lying ones, it is important to take the blocking effect into account. The influence of the number conservation is investigated. Energies of nuclear states and their theoretical level structure, allowed and K-forbidden gamma-ray transitions in odd-mass rare earth nuclei are calculated and compared with the experimental values. Good agreement with experimental results is obtained for M1 transitions; K-forbidden E1 transitions are about an order of magnitude too fast. (7 tables) (auth)

26412 SYMPOSIUM ON NUCLEONS AND WEAK INTERACTIONS, ZAGREB, YUGOSLAVIA, JULY, 1971. Eman, B.; Tadic, D. (eds.). Zagreb; Institute Rudjer Boskovic (1971). 343p. (CONF-710737-).

From Symposium on nucleons and weak interactions; Zagreb, Yugoslavia (Jul 1971).

The conference included 16 papers one of which was abstracted previously in NSA. For an abstract of this paper see abstract number 26: 32128. Separate abstracts were prepared for 14 papers. Other papers were outside the scope of NSA. (JFP)

For abstracts of individual papers see: 25837, 25838, 25932, 25934, 26087, 26119, 26165, 26278, 26279, 26311, 26413, 26414, 26427, and 26428.

26413 CALCULATION OF PARITY VIOLATING EFFECTS IN NUCLEI. Kuemmel, H. (Ruhr-Univ., Bochum, Ger.). pp 113-135 of Symposium on Nucleons and Weak Interactions. Eman, B.,(ed.). Zagreb; Institute Rudjer Boskovic (1971).

From Symposium on nucleons and weak interactions; Zagreb, Yugoslavia (Jul 1971). See CONF-710737-.

A summary of research on parity violating effects in decay and energy-level transitions in nuclei is given. (JFP)

26414 INDUCED PSEUDOTENSOR INTERACTION AND THE NONRELATIVISTIC APPROXIMATION. Eman, B.; Tadic, D. (Inst. Rudjer Boskovic, Zagreb). pp 327-334 of Symposium on Nucleons and Weak Interactions. Eman, B. (ed.). Zagreb; Institute Rudjer Boskovic (1971).

From Symposium on nucleons and weak interactions; Zagreb, Yugoslavia (Jul 1971). See CONF-710737-.

The nonrelativistic approximation is formulated for the induced pseudotensor in beta decay theory. (JFP)

26415 BARYON RESONANCES IN NUCLEI. Danos, M. (National Bureau of Standards, Washington, DC). J. Phys. (Paris), Colloq.; No. 5, C5.171-C5.182(1972).

The problems encountered when incorporating baryon resonances and mesons into the nuclear wave function are discussed. Since no workable strong-interaction theory exists, they must be attacked in a quasi-theoretical step-by-step manner. The present status in understanding is discussed; and possible future development suggested. (FR)

26416 CALCULATED NEARLY DEGENERATE ISOSPIN DOUBLETS. Goode, P.; Zamick, L. (Rutgers-The State Univ., New Brunswick, NJ). Phys. Lett.; 43B: No. 3, 183-185(5 Feb 1973).

It is noted that in several calculations of the odd J states of N = Z nuclei ^{36}Ar, ^{44}Ti, and ^{52}Fe, there is a near degeneracy of the lowest T = 0 and lowest T = 1 states, for several J values. Qualitative physical reasons for this behavior are given and the Coulomb mixing is estimated. (auth)

26417 INFLUENCE OF CORIOLIS ANTIPAIRING AND ALIGNMENT ON THE ROTATIONAL STATES IN NUCLEI. Damgaard, J.; Faessler, A. (Kernforschungsanlage, Juelich, Ger.). Phys. Lett.; 43B: No. 3, 157-159(5 Feb 1973).

The inclusion of both Coriolis anti pairing (CAP) and alignment in the simple $i_{13/2}$ model is studied. It is found that "backbending" occurs for too small angular frequencies in such a model. (auth)

26418 ELASTIC ELECTRON SCATTERING BY ^{11}B. Ros, J. (Dept. of Theoretical Physics, Oxford); Bernabeu, J. Phys. Lett.; 43B: No. 3, 178-182(5 Feb 1973).

The wave function of Cohen and Kurath is used to analyze elastic electron scattering by ^{11}B. The effect of the configuration mixing on the different form factors is discussed. (auth)

26419 IMPORTANCE OF INDIRECT PROCESSES IN ONE-PARTICLE-TRANSFER REACTIONS INDUCED BY HEAVY IONS. Landowne, S.; Broglia, R. A.; Liotta, R. (Univ. of Copenhagen). Phys. Lett.; 43B: No. 3, 160-164(5 Feb 1973).

The reaction ^{96}Zr(^{16}O,^{15}N)^{97}Nb to the $|1\,g_{9/2} \otimes 3^-(^{96}\mathrm{Zr});\ j\rangle$ septuplet is calculated in the coupled channel Born approximation. Direct and indirect transfer processes are found to be of the same order of magnitude and show similar j-dependence. (auth)

26420 COULOMB PROBLEM FOR SCATTERING STATES IN THE GENERATOR COORDINATE METHOD. Phys. Lett.; 43B: No. 3, 165-166(5 Feb 1973).

The proportionality of the Hill-Wheeler amplitude f and of the scattering wave function g for large separation distance is proved for Coulomb + nuclear scattering. Practical problems are discussed. (auth)

26421 DIRECT VS. COMPOUND PROCESSES: PRODUCTION AND DE-EXCITATION OF HIGH ANGULAR MOMENTUM STATES. Morinaga, H. (Technische Univ., Munich). J. Phys. (Paris), Colloq.; No. 5, C5.103-C5.110(1972).

Specific features of heavy-ion reactions which have no direct parallelism with reactions involving light nuclei are discussed, the shapes of highly excited nuclei being given. Examples of the use of heavy-ion reactions in nuclear spectroscopy are presented. (FR)

26422 DWBA ANALYSIS OF MULTITRANSFERS BETWEEN HEAVY IONS. El Baz, E.; Meyer, J.; Nahabetian, R.; Pigeon, J. (Lyon Univ., Villeurbanne, France). J. Phys. (Paris), Colloq.; No. 5, 65(1972). (In French).

The A(a,b)B reaction between heavy ions in the transfer of a particle cluster is described by the DWBA in terms of the transition amplitude. Normally, nuclear recoil effects are neglected or approximately treated using the Dood and Greider method; an exact calculation is presented. (FR)

26423 HADRON-NUCLEUS AND NUCLEUS-NUCLEUS SCATTERING AT HIGH ENERGIES. Balashov, V. V. (State Univ., Moscow). J. Phys. (Paris), Colloq.; No. 5, C5.127-C5.140(1972).

Current studies of hadron-nucleus and nucleus-nucleus scattering at energies above 100 MeV are reviewed. (FR)

26424 COULOMB CORRECTIONS TO NUCLEAR BETA DECAY. Bottino, A.; Ciocchetti, G. (Univ., Turin). Phys. Lett.; 43B: No. 3, 170-174(5 Feb 1973).

A calculation of the Coulomb correction to the nuclear beta decay is presented, in the context of the elementary-particle treatment of Kim and Primakoff, making use of the low energy approximants to nuclear form factors. (auth)

26425 COMMON FEATURES AND DIFFERENCES BETWEEN FISSION AND HEAVY ION PHYSICS. Swiatecki, W. J. (Univ. of California, Berkeley). J. Phys. (Paris), Colloq.; No. 5, C5.45-C5.60(1972).

The macroscopic approach to fission and fusion physics is formulated. A minimum set of three degrees of freedom is described qualitatively. The gross features of the potential energy in this configuration space are discussed. The problem of nuclear viscosity is mentioned, and comparisons with liquid ^{3}He are made. Some effects of large angular momenta are described. (auth)

26426 MICROSCOPIC VIEW OF NUCLEAR COLLECTIVE PROPERTIES. Baranger, M. (Massachusetts Inst. of Tech., Cambridge). J. Phys. (Paris), Colloq.; No. 5, C5.61-C5.71 (1972).

After discussing the concepts of nuclear shape, deformation, and softness, the various microscopic theories of collective motion are reviewed, and the problem of their interdependence is discussed. The adiabatic time-dependent Hartree-Fock approximation is treated in more detail. (FR)

26427 EFFECTIVE INTERACTIONS IN NUCLEAR BETA-DECAY. Gabrakov, S. I.; Pyatov, N. I. (Joint Inst. for Nuclear Research, Dubna, USSR). pp 223-257 of Symposium on Nucleons and Weak Interactions. Eman, B. (ed.). Zagreb; Institute Rudjer Boskovic (1971).

From Symposium on nucleons and weak interactions; Zagreb, Yugoslavia (Jul 1971). See CONF-710737-.

A review is given of models for the hindered Gamow-Teller transitions, the distribution of the strength of these transitions over the spectra of excitations, Fermi beta decay, and the values of the nuclear matrix elements for allowed beta decay of medium and heavy nuclei with N > Z. (JFP)

26428 MESON-EXCHANGE EFFECTS IN $^3\mathrm{H} \rightarrow {}^3\mathrm{He} + e^- + \bar{\nu}$ Fischbach, E. (Purdue Univ., Lafayette, IN); Harper, E. P.; Kim, Y. E.; Tubis, A.; Cheng, W. K. pp 259-281 of Symposium on Nucleons and Weak Interactions. Eman, B. (ed.). Zagreb; Institute Rudjer Boskovic (1971).

From symposium on nucleons and weak interactions; Zagreb, Yugoslavia (Jul 1971). See CONF-710737-.

The preliminary results of a calculation of the meson exchange corrections to triton decay are presented. (JFP)

26429 GIANT ISOVECTOR EXCITATIONS IN ATOMIC NUCLEI. Akyuez, R. O. Providence; Brown Univ. (1972). 130p. University Microfilms Order No. 73-2222.

THESIS (PH. D.).

The study of some properties of isovector excitations in nuclei is presented. These, by definition, include the totality of transitions, induced in a nucleus by an external interaction of isovector character, i.e., one that transforms as a vector in isospin space. The isovector interaction has obviously three components, with each one corresponding to a different physical process. The third component leads to excited states in the same nucleus e.g., photoabsorption, inelastic electron or nucleon scattering, etc. The other two (spherical) components, however, are charge transfer operators, and lead to excited states in neighboring nuclei by, e.g., μ^--capture, and (p,n), (n,p), (π^-,γ), etc., processes. Selection rules, derivable from standard vector coupling arguments, impose restrictions on the isospin of the excited states that can be reached from the ground state through the action of an isovector operator. If T_0 and T denote respectively the isospins of the ground and an excited state, it is well known for example that $T_0 = 0 \rightarrow T = 0$ transitions are forbidden, and that the only possible values for $\Delta T = T - T_0$ are, $\Delta T = \pm 1$ or 0. Although in most stable nuclei, the projection M of isospin operator ($M = \frac{1}{2}(Z-N)$, Z:number of protons, N:number of neutrons), equals to T_0 in absolute value, and therefore excited states with $T = T_0 - 1$ do not appear, their presence in neighboring (unstable) nuclei is still of interest, since it is possible to reach them via e.g., (p,n) reactions. We investigate the average excitation energies of the excitations with iso-

spins $T_0 + 1$, T_0, $T_0 - 1$, and the systematics of their relative displacements in energy. We also consider the relative total strengths of the transitions from the ground state to the excited states with isospins $T_0 + 1$, T_0, $T_0 - 1$. The presentation includes a discussion of sum rules dealing separately with different isospin components, and the derivation of a formalism on which microscopic calculations can be based. In this connection it is noticed that the random phase approximation, a method often very useful for microscopic calculations, needs modification before becoming applicable to nuclei with a nonvanishing neutron excess. This is because, in its traditional formulation, this method tends to destroy charge independence due to an uneven truncation of the Hilbert space. This is not true for light nuclei, when $T_0 = 0$, i.e., there is no neutron excess and the method is perfectly consistent in this case. For heavier nuclei problems appear, but was not properly appreciated at the time when isospin was not considered to be of any significance for such nuclei anyway. Some numerical results are also obtained and a comparison of the theoretical predictions with experimental results is presented. (Diss. Abstr. Int., B)

26430 MODIFICATION OF HAUSER–FESHBACH CALCULATIONS BY DIRECT-REACTION CHANNEL COUPLING. Kiwai, M. State Univ. of New York, Stony Brook); Kerman, A. K.; McVoy, K. W. Ann. Phys. (N. Y.); 75: No. 1, 156-170(Jan 1973).

If open channels are strongly coupled by direct reactions, the traditional Hauser–Freshbach method of calculating fluctuation cross sections is invalid, because of nonstatistical correlations which the direct channel-coupling induces between resonance partial widths in different channels. The fluctuation cross sections can still be computed from the optical S-matrix elements, however, and the formulas necessary for doing so are obtained here with the aid of an "optical background" representation of the full S matrix. The resulting compound-elastic cross section is increased over the Hauser–Feshbach expression by a factor of $2(\Gamma \gg D)$ or $3(\Gamma \ll D)$ in the large-N limit, and compound-reaction cross sections are increased by roughly a factor of $(N + 1)/N$, where N is the number of directly-coupled open channels. (auth)

26431 DETERMINATION OF OPTICAL MODEL PARAMETERS. Vos, H. Amsterdam; Vrije Universiteit (1972). 137p. Thesis.

The purpose of this work was to find a method that gives dependable errors for the optical-model parameters and that provides information about the correlations between the parameters and indicates the independent parameters of the model. Straightforward methods to reach this end cannot be used because of the numerical inaccuracy in the calculation of χ^2. A transformation of the χ^2 surface in a local quadratic approximation to the principal directions as parameter axes makes the determination of errors, correlations, and independent parameters possible. A number of different ambiguities are considered, including the following: Vr_R^2, V and a_R, volume integral, $W_d \cdot a_I$, W and W_d, and a_{SO}. (19 figures, 21 tables) (RWR)

26432 TIME INTERVAL DISTRIBUTION OF PARENT–DAUGHTER DECAY. Lewis, V. E. (National Physical Lab., Teddington, Eng.). Int. J. Appl. Radiat. Isotop.; 24: No. 1, 63-64 (Jan 1973).

The time interval distribution between successive events in parent–daughter decay is derived. The equation obtained disagrees with earlier work (Devol and Ruark, Phys. Rev.; 51: 710 (1937)) which appears to have an arithmetical error. However, agreement is shown with recent work of Mueller (1972). (UK)

26433 METHOD OF CALCULATION OF J-FIXED SHELL MODEL SPECTRAL DISTRIBUTION. Jacquemin, C. (Institut de Physique Nucleaire, Orsay, France). Phys. Lett.; 43B: No. 4, 253-258(19 Feb 1973).

By a proper definition of configurations it is shown that moments of H can be calculated in a shell-model subspace with fixed angular momentum. (auth)

26434 DELAYED NEUTRONS AT THE FINAL STAGE OF THE R-PROCESS. Kodama, T. (Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro); Takahashi, K. Phys. Lett.; 43B: No. 3, 167-169(5 Feb 1973).

The gross theory of beta decay is applied to the r-process calculation. In particular, it is explicitly shown that the delayed-neutron emissions at the final stage of the r-process smooth out the abundance curve significantly. (auth)

26435 IMAGINARY PART OF THE OPTICAL POTENTIAL IN ^{12}C. El Naggar, N. M. (Assiut Univ., Egypt). J. Natur. Sci. Math.; 12: No. 1, 19-29(Apr 1972).

The imaginary part of the optical potential in ^{12}C is studied within the framework of the shell model. The results of the calculations are compared with other theoretical results. (auth)

26436 TOTAL ENERGY BALANCE IN FISSION. Ghani, A.; Ikramulhaq, M. (Pakistan Inst. of Nuclear Science and Tech., Rawalpindi). J. Natur. Sci. Math.; 12: No. 1, 39-44(Apr 1972).

The total energy balance in fission of ^{252}Cf, ^{235}U, ^{239}Pu and ^{226}Ra has been investigated. Some discrepancies are observed between E_T and the fission Q-values. The mass formula by Garvey et al. gives accurately the masses of neutron-rich nuclei lying in regions far from the stable mass valley. (auth)

PHYSICS (PLASMA AND THERMONUCLEAR)

26437 PLASMA PHYSICS INDEX. Volume 8, No. 2, 1973. Bibliography, author index, subject index. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1973). 139p.

This listing contains 443 references on various aspects of plasma physics. (MOW)

26438 TECHNOLOGY INDEX FOR PLASMAPHYSICS RESEARCH AND FUSION REACTORS. Volume 7, No. 2, 1973. Bibliography, Author Index, Subject Index, Appendix. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergi Dokumentation (1973). 69p.

This listing contains 313 references. (MOW)

26439 TECHNOLOGY INDEX FOR PLASMAPHYSICS RESEARCH AND FUSION REACTORS. Volume 7, No. 1, 1973. Bibliography, author index, subject index, appendix. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1973). 57p.

This listing contains 281 references on various aspects of plasma physics and controlled fusion research. (MOW)

Confinement and Heating

Refer also to abstracts 26508 and 26687.

26440 (AD-749970) NONLINEAR LASER HEATING OF A PLASMA. Technical Report, March 1, 1971–29 February 1972. DuBois, D. F.; Goldman, M. V. (Hughes Research Labs., Malibu, Calif.). Sep 1972. Contract F29601-71-C-0052. 228p. (AFWL-TR-72-101). NTIS.

The heating of a dense plasma by a laser through the excitation of parametric instabilities is examined in detail. These instabilities convert laser energy into plasma density fluctuations (or waves) which ultimately result in particle heating by collisionless and collisional wave damping. A comprehensive nonlinear weak-turbulence theory of the saturation of these instabilities is developed, and the saturated plasma wave spectrum for the case of nearly equal electron and ion temperatures is computed. The saturated wave level permits the calculation of the nonlinear absorption coefficient of the laser which can be considerably enhanced over the linear (inverse bremsstrahlung) value for typical laser power densities. The self-consistent propagation of the laser beam, including this nonlinear absorption in an overdense inhomogeneous plasma, is studied in a one-dimensional model; and the reflection coefficient as a function of incident power is computed. (auth)

26441 (CONF-720404-(Vol. 1), pp 416-429) SOFT X-RAY EMISSION FROM DOUBLE-ELECTRON RADIATIVE TRANSITIONS IN PLASMA IONS. Elton, R. C.; Palumbo, L. J. (Naval Research Lab., Washington, DC). Jan 1973.

From International conference on inner shell ionization phenomena and future applications; Atlanta, Georgia, USA (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

A broad emission blend is observed near 17 Å from a plasma produced in a theta-pinch deuterium discharge seeded with neon. The feature is associated with $KL^m \rightarrow L^{m+2} + h\nu$ ($m \leq 6$) double-electron radiative transitions resulting from the filling of a K-shell vacancy in the higher ionization species of the neon atoms by an L-shell electron, the simultaneous ionization (shake-off) or excitation (shake-up) of a second L-shell electron, and the emission of a photon. The observed spectral distribution of the blend is compared with the spectral distributions computed for various ion species by convoluting the instrument profile of the spectrograph with the predicted wavelengths and relative intensities of the shake-up lines and shake-off continua. A percentage probability for radiative-Auger shake-off in agreement with theory is derived from the Ne VIII portion of the measured spectrum. The possibilities of such transitions for enhanced plasma cooling and for gain by stimulated emission are mentioned. (auth)

26442 (CONF-730315-2) NEUTRAL BEAM INJECTION HEATING OF ORMAK. Stewart, L. D.; Davis, R. C.; Hogan, J. T.; Jernigan, T. C.; Morgan, O. B.; Stirling, W. L. (Oak Ridge National Lab., TENN). 1973. 4p. Dep. NTIS $3.00.

From 3rd international symposium on toroidal plasma confinement; Garching, F. R. Germany (26 Mar 1973).

A basic ORMAK neutral injection heating module has been developed which is capable of delivering 120 kW to the plasma with acceptable levels of impurities and streaming neutral gas. Each injector can supply atomic neutrals at three different energies simultaneously, so that 12 simultaneous energies can be supplied with four injectors. The neutralizing cell begins immediately after the extraction region and uses only the excess hydrogen gas from the source. The system is described. (MOW)

26443 (EUR-4938, pp 1-12) ALL-METAL LINER FOR T.T.M.P. HEATING. Consoli, T.; Jeffroy, G.; Nagao, S.; Zymanski, S. (CEN, Grenoble, France). Dec 1972.

From seventh symposium on fusion technology; Grenoble, France (24 Oct 1972).

The future of heating and stabilization by rf field of hot plasma, particularly in a toroidal device, is strongly related with the exclusion of insulating material. A metallic liner between the plasma, the rf coil and the wall, has to be used. This liner has to be transparent to the rf field, bakeable and non-lossy. The paper describes solutions for reaching this aim. (EU)

26444 (MATT-949) REACTOR INJECTION, DIVERSION, AND PLASMA PROFILES. Mills, R. G. (Princeton Univ., N. J. Plasma Physics Lab.). Jan 1973. Contract AT(11-1)-3073. 55p. Dep. NTIS $4.75.

Three lectures given at the International School of Fusion Reactor Technology, Erice, Sicily, September 1972 are included. They include the following: (1) the problem of fuel injection, (2) design problem of divertors, and (3) temperature and density profiles of a steady state reactor. (MOW)

26445 SOME AVERAGED PROPERTIES OF WAVE SOLUTIONS FOR A HYPERSONIC THERMAL WAVE. Kaliski, S. (Inst. of Fundamental Technological Research, Warsaw). Bull. Acad. Pol. Sci., Ser. Sci. Tech.; 20: No. 9, 641-648(1972).

Methods for obtaining averaged equations of laser heating of plasma are considered via discussion of simplified models of an elastic medium with a thermal wave traveling at finite hypersonic speed. A plane wave in an infinite and semi-infinite body is examined. It is shown that, for $(a/c) \ll 1$, the accurate and averaged solutions are in good agreement, for simplified elastic models. The equations are modified for $(a/c) \ll 1$. One may expect that similar relations will hold for more general conditions of laser heating of plasma than those in the simplified cases considered. (auth)

26446 ACHIEVEMENT OF POWERFUL LIGHT PULSES AT 1.06- AND 0.53-μ WAVELENGTHS AND THEIR APPLICATION FOR PLASMA HEATING. I. Bi-Wavelength Experimental Study of the Reflection Radiation Under Laser Heating of Plasma. Basov, N. G.; Zaritskii, A. R.; Zakharov, S. D.; Krokhin, O. N.; Kryukov, P. G.; Matveets, Yu. A.; Senatskii, Yu. V.; Fedosimov, A. I. Kvantovaya Elektron. (Moscow); No. 5, 63-71(1972). (In Russian).

Experimental results on calorimetric, temporal, spectral, and polarization measurements of the back-reflected radiation from the plasma produced by 1.06- and 0.53-μ laser radiation at target fluxes exceeding 10^{14} W/cm^2 are described. It was found that plasma absorption of the heating light at 0.53 μ was in 3 times higher than at 1.06 μ. (auth)

26447 NEW APPROACH TO GENERATION OF TOKAMAK FLUID CODES USING THE PL/1-FORMAC INTERPRETER. Rosen, B. (Stevens Inst. of Tech., Hoboken, NJ); Okabayashi, M. Nucl. Fusion; 13: No. 1, 3-6(Jan 1973).

Recently, with the advance of the plasma diffusion theory of toroidal devices and the success of experimental results of the tokamak, octupole and spherator, quantitative comparison between the existing diffusion theory and the experimental results is necessary for an understanding of plasma diffusion in the magnetic trap. Here, the authors demonstrate the use of FORMAC(Formula Manipulation Compiler) to carry out the analytical work and to prepare the corresponding portion of the FORTRAN program necessary to solve the equations numerically. (auth)

26448 LOWER-HYBRID-RESONANCE HEATING OF A PLASMA IN A PARALLEL-PLATE WAVEGUIDE. Puri, S.; Tutter, M. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). Nucl. Fusion; 13: No. 1, 55-62(Jan 1973).

Wave propagation in a parallel-plate metallic waveguide partially filled with an inhomogeneous, anisotropic plasma column is studied as an eigenvalue problem using the complete cold-plasma dielectric tensor. Although the accessibility condition may not be met,

the collisional energy absorption at the lower-hybrid resonance greatly exceeds the resistive loss at the waveguide walls resulting in a very high plasma heating efficiency. The heating continues to be effective even for very low collision frequencies encountered in thermonuclear plasmas. Detailed numerical results for the heating efficiency, energy flux into the plasma, energy density and dissipation density in the plasma column as well as group velocity are presented. Also the effects of density profile, collision frequency, and waveguide eigenmodes are discussed. (auth)

26449 EFFECT OF A METALLIC REFLECTOR UPON CYCLOTRON RADIATION. Krajcik, R. A. (Lewis Research Center, Cleveland). Nucl. Fusion; 13: No. 1, 7-16(Jan 1973).

A careful study of the effect of a metallic reflector upon cyclotron radiation emanating from a uniform plasma is made in which the angular, polarization, and frequency dependence of both the cyclotron radiation and the metallic reflector is taken into account. The properties of the metallic reflector then enter in a natural way and share equal status with the properties of the plasma. The radiation coefficient, the ratio of the cyclotron radiation absorbed by the reflector to that generated by the plasma, becomes a function of the two parameters: T_e, the electron temperature, and $\ln_e/B(B\rho)^{\frac{1}{2}}$, the plasma depth to cyclotron radiation, where l is the perpendicular distance across the reflector, n_e is the electron density, B is the magnetic field, and ρ is the resistivity of the reflector. The radiation coefficient is determined for both slab and cylindrical geometries for the range of values $20 \leq T_e \leq 120$ (keV) and $10^{19} \leq \ln_e/B(B\rho)^{\frac{1}{2}} \leq 10^{21}$(MKS). A simple analytic approximation is given for the radiation coefficient for each geometry, and the results are then applied to a low-β thermonuclear device based on the D–D reaction. For β of the order of 1 to 2%, and for devices of moderate size (l of the order of a few metres), the metallic reflector is incapable of reducing the cyclotron radiation loss below that required for a self-sustained D–D reaction. (auth)

26450 BOOTSTRAP CURRENT IN TOKAMAKS WITH NEUTRAL INJECTION. Sigmar, D. J. (Massachusetts Inst. of Tech., Cambridge). Nucl. Fusion; 13: No. 1, 17-25(Jan 1973).

For a diffuse pinch plasma in the near collisionless ("banana") regime, the fast ion current produced by injection of ≥10-A, 30-keV neutral hydrogen constitutes a sufficient seed current for the bootstrap effect. Assuming an effective ion charge number $Z \sim 2$ due to impurities, the seed current density on the magnetic axis is calculated and incorporated into the steady-state moment equations describing the bootstrap equilibria of Bickerton et al. In the parameter space spanned by the seed current and the mass input, a practically accessible region exists where m = 1 (kink) and resistive modes may be avoided. With present technology the injection-driven bootstrap current may double the Ohmic current, but the concomitant mass input for injection parallel to the magnetic axis is too small to compensate for the neoclassical diffusion losses. The theory is applied to the ORMAK and PLT experiments. (auth)

26451 ABSORPTION OF LIGHT AT OBLIQUE INCIDENCE ON A PLASMA LAYER. Burnet, N. H. (Univ. of Alberta, Edmonton). Can. J. Phys.; 50: No. 24, 3184-3192(15 Dec 1972).

Two effects are examined which may lead to enhanced absorption of light by sharply bounded plasma layers at oblique incidence. The first is a resonance absorption caused by interference of light reflected from the front and rear boundaries of the layer. The second is the linear coupling of the incident transverse wave into longitudinal plasma waves. It is thought that these effects may be useful in obtaining increased efficiency in laser heating of plasmas. (auth)

26452 PARAMETRIC HEATING OF A DENSE ARC PLASMA WITH 0.337 MM LASER RADIATION. Jassby, D. L. (School of Engineering and Applied Science, University of California, Los Angeles, California 90024). J. Appl. Phys. 44: No. 2, 919-920 (Feb 1973).

The threshold intensity of 0.337 mm laser radiation for excitation of the parametric decay instability in a helium arc plasma at 4.0 eV is computed. The plasma density gradient reduces the intensity required from the laser by a factor of 16. (auth)

26453 HEATING OF Θ-PINCH PLASMAS BY PULSED CO_2 LASERS. Fuchs, V. (Hydro-Québec Institute of Research (IREQ), Varennes, Québec, Canada). J. Appl. Phys. 44: No. 3, 1168-1173 (Mar 1973).

The problem of heating a uniform Θ-pinch plasma by a pulsed CO_2 laser is considered. The effort is concentrated on determining the final temperature of the plasma while taking into account its radial expansion against the confining magnetic field. It is shown how the final temperature scales with the pinch-tube filling factor and the ratio of the laser energy to the initial internal energy of the plasma. The results indicate that for large filling factors it is convenient to heat the plasma quasistatically with the use of laser pulses longer than the time it takes for an acoustic wave to traverse the plasma radius. For small filling factors, rapid heating becomes more efficient than quasistatic heating when the laser energy is much larger than the initial internal energy of the plasma. (auth)

26454 PLASMA HEATING EFFECTS IN THE PRESENCE OF A PARAMETRIC DECAY INSTABILITY. Keen, B. E.; Fletcher, W. H. W. (United Kingdom Atomic Energy Authority, Abingdon, Eng.). J. Phys., A (London); 6: No. 3, L24-L29(Mar 1973).

Experimental results are presented which show that, above a certain threshold value, a large-amplitude electron Bernstein wave can decay into another Bernstein wave plus a low-frequency (lf) ion cyclotron wave. At increased incident-wave amplitudes, a whole spectrum of lf ion waves appeared, with frequencies extending up to the ion plasma frequency. Simultaneous with the excitation of this spectrum of ion waves, measurement of both ion and electron temperatures indicated increases in value up to 2.5 times their initial values. (auth)

26455 PLASMA CONFINEMENT IN THE POLOIDAL HELIOTRON MAGNETIC FIELD. Oshiyama, H. (Kyoto Univ.). Plasma Phys.; 15: No. 3, 177-191(Mar 1973).

Plasma confinement in the Poloidal Heliotron field is studied experimentally. Plasma is injected from a rail-type plasma gun and the plasma parameters are ion temperature = 8 eV, electron temperature = 3 eV, and density 5×10^{10} to 5×10^{11} cm^{-3}. The plasma equilibrium, the effect of a stagnation region on the confinement and the convective cell responsible for the particle loss are examined by measuring the floating potential, the density profile and the loss flux. (auth)

26456 THEORY OF ELECTRON CYCLOTRON RESONANCE HEATING. 2. Long Time and Stochastic Effects. Lieberman, M. A.; Lichtenberg, A. J. (Univ. of California, Berkeley). Plasma Phys.; 15: No. 2, 125-150(Feb 1973).

The theory of single-particle electron cyclotron resonance heating in a magnetic mirror is treated analytically and numerically, from the viewpoint of (a) an impulsive heating approximation and (b) a stochastic approximation, using a Fokker–Planck equation. Using (a), numerical calculations of particle heating are performed for 10^5 half-bounce times. Numerically and analytically from (a), for a given rf field strength, two limiting energies are obtained. For the transverse particle energy at resonance, invariant curves do not exist, the random phase assumption holds, and the particle heating is stochastic, described by a Fokker–Planck equation. Analytic results are in agreement with exact numerical calculations. (auth)

26457 INVESTIGATION OF THE MECHANISM OF HEATING OF THE PLASMA ELECTRON COMPONENT UNDER BEAM INSTABILITY CONDITIONS IN A MIRROR TRAP. Demirkhanov, R. A.; Gevorkov, A. K.; Popov, A. F.; Kolmakov, O. A. Zh. Eksp. Teor. Fiz.; 63: No. 5, 1653-1663(Nov 1972). (In Russian).

The effect of magnetic field inhomogeneity on plasma heating by an electron beam in a magnetic mirror trap of the mirror machine type is investigated experimentally. The possibility is demonstrated of efficient linear absorption of energy of oscillations, excited by the beam in the plasma, in an inhomogeneous magnetic field. The data obtained confirm the mechanism of stochastic cyclotron heating of the plasma electron component in a mirror trap. The heating efficiency is maximal when the spectrum of oscillations excited by the beam in the plasma lies in the cyclotron frequency range of the mirror machine. (auth)

Diagnostics

Refer also to abstracts 26590 and 26603.

26458 (AD-748280) FAR-INFRARED SPECTROSCOPIC SYSTEM FOR PLASMA DIAGNOSTICS. McNulty, B. A.; Sesnic, S. S. (Texas Univ., Austin. Electronics Research Center). 1 Jun 1972. Contract F44620-71-C-0091. 83p. (AFOSR-TR-72-1195). NTIS.

The far-infrared portion of the electromagnetic spectrum has, until very recently, been the least accessible to experimentalists in the field of plasma diagnostics. Within the last decade, the availability of fast, sensitive detectors, known calibration sources, and rapid advancement in the field of fusion plasma research, have made the far-infrared region quite viable and attractive in diagnostics. By far the most versatile and useful instrument in this area is the vacuum grating spectrometer. Thus a far-infrared spectroscopic system, the heart of which is a vacuum grating spectrometer, was built for plasma spectroscopy studies on the Texas Tokamak. The work described here specifies the system

and defines some of the more important operating characteristics of the spectrometer. (auth)

26459 (EUR-4938, pp 51-56) STABILIZED He–Ne LASER INTERFEROMETER WITH HIGH RESOLUTION AND LARGE BANDWIDTH. Weisberg, K. V. (Research Center, Risoe, Denmark). Dec 1972.

From seventh symposium on fusion technology; Grenoble, France (24 Oct 1972).

An interferometer operating at 3.39 μ with a resolution better than one hundredth of a fringe and a bandwidth of several MHz is described. The stabilizing system was designed to be very easy to use. The working point on the fringe and the feedback level are the only two independent controls. The measures taken to obtain fast response and high stability, the choice of the transducer for the moving mirror, the calibration methods and problems related to the power supplies for the laser are described. (auth)

26460 (EUR-4938, pp 57-62) TEN-CHANNEL MICROWAVE INTERFEROMETER FOR ELECTRON-DENSITY MEASUREMENT IN TFR TOKAMAK. Crenn, J. P. (CEN, Fontenay-aux-Roses, France). Dec 1972.

From seventh symposium on fusion technology; Grenoble, France (24 Oct 1972).

A ten channel microwave interferometer is being built at Fontenay-aux-Roses, with the purpose of measuring the spatial distribution of the electron density in T.F.R. Tokamak. The ten channels will be in the vertical direction and regularly spaced over a cross section of the plasma column. Each channel will yield a measurement of the microwave phase shift through the plasma column. It will be possible to infer the spatial distribution of the electron density by inversion of the Abel integral. The measured density will be in the range 10^{12} e-cm^{-3} to 5×10^{13} e-cm^{-3}, the microwave frequency will be 140 or 300 GHz, according to the value of the density. With these frequencies, it is preferable to use microwave components built with oversize waveguides. Associated electronic devices will permit to obtain the so-called "zebra-stripes" display on an oscilloscope screen, giving the phase shifts independently of the amplitude of the wave. (auth)

26461 (EUR-4938, pp 63-67) HIGH-SENSITIVITY HCN INTERFEROMETER APPLICATION TFR. Blanc, P.; Veron, D. (CEN, Fontenay-aux-Roses, France). Dec 1972.

From seventh symposium on fusion technology; Grenoble, France (24 Oct 1972).

A high-sensitivity interferometer working at a wavelength of 337 μ is described. The source is a 30-mW, HCN laser designed to ensure long-term stability and reliability. Instant mode selection is made by using a liquid crystal camera. The frequency (890 10^9 Hz) of one of the two beams of the interferometer is Doppler shifted by a small amount. When the two beams are mixed, a sine wave at the beating frequency is obtained. This wave is phase shifted by the same quantity than the probing beam upon traversing the plasma. To check the validity of the system, a Michelson-type interferometer has been built. Doppler effect is produced by a cylindrical rotating echelette grating. The standard deviation of the beating frequency at 10^4 Hz is of the order of 3% corresponding to an upper limit of the sensitivity of 0.003 fringe. Taking in account the geometrical disposition of T.F.R. windows, a space resolution of the order of 1 cm should be attainable in density measurements. (auth)

26462 (EUR-4938, pp 69-75) EXPERIENCE GAINED WITH A HIGH-SPEED DATA-ACQUISITION SYSTEM. Hopmann, W.; Huettemann, P. W.; Waidmann, G. (Institut fuer Plasmaphysik, Juelich, Ger.). Dec 1972.

From seventh symposium on fusion technology; Grenoble, France (24 Oct 1972).

A high-speed ADC using storage tubes has been built. The system allows one to digitize simultaneously up to five signals, each digitizing channel producing 250 samples within 5 μsec at maximum speed. The data acquisition was used firstly for the evaluation of electrostatic double probe characteristics delivering the values of electron temperature and ion density. Then an attempt was made to determine the position of the plasma in a toroidal, axisymmetric plasma preheat experiment by evaluating the signals delivered from magnetic probes. (auth)

26463 (EUR-4938, pp 77-82) COMPUTER-BASED DATA PROCESSING SYSTEM FOR FUSION EXPERIMENTS. Murphy, E. G.; Fullard, K.; Steed, C. A. (Culham Lab., Abingdon, Eng.). Dec 1972.

From seventh symposium on fusion technology; Grenoble, France (24 Oct 1972).

Data acquisition hardware and software designed on modular principles which have just come into operation on two fusion experiments are described. (auth)

26464 (EUR-4938, pp 83-88) SYSTEM ASPECTS OF DATA ACQUISITION AT CULHAM. Calderbank, M.; Read, A. H. (Culham Lab., Abingdon, Eng.). Dec 1972.

From seventh symposium on fusion technology; Grenoble, France (24 Oct 1972).

The Integrated Data Acquisition system which has been set up at Culham to serve three fusion experiments and the electronic development laboratory is described. Each of the four experimental areas is equipped with a local small computer and a comprehensive range of data acquisition, output and transmission equipment. The computers are connected, by means of high-speed data links, to a similar small computer which "front-ends" the Laboratory's central computer. The central computing system acts as a bulk data-storage and archiving facility and as a source of program overlays which considerably enhance the power of the remote machines. To permit the efficient operation of the overall system, a comprehensive software package has been prepared which provides access to files on both the "front-end" and main-frame machines and permits a remote computer to start-up a job on the main-frame machine and retrieve the results when the job has been completed. (auth)

26465 (FRNC-TH-286) MEASUREMENT OF THE ATOMIC AND IONIC TEMPERATURE OF A PLASMA BY X-RAY ABSORPTION SPECTROMETRY. Lacaze, R. M. 1971. 52p. (In French). Dep. NTIS (U. S. Sales Only).

Thesis.

A new method was developed for measuring the heavy particles of a plasma. The method is applicable over a large range of thermodynamic magnitudes: pressure, temperature, density, and electron density. Equipment enabling measurements to be made of the attenuation of an x-ray beam by a variable length of plasma was developed. An argon plasma in thermodynamic equilibrium was used. The use of a bent crystal monochromator allowed the measurements to be effected as a single recording for two wavelengths situated at the ends of the argon K absorption (3.8 Å). Comparison of the results obtained with the electronic temperature deduced from optical spectroscopy measurements demonstrated that the accuracy is sufficient for relatively large wavelengths (40 to 50 Å). (France)

26466 (UCRL-51348) MICROWAVE MEASUREMENTS OF 2XII RADIAL AND LONGITUDINAL ELECTRON DENSITY PROFILES. Simonen, T. C.; Coensgen, F. H.; Cummins, W. F.; Finlayson, V. A.; Molvik, A. W.; Neilson, G. H. Jr.; Nexsen, W. E. Jr. (California Univ., Livermore. Lawrence Livermore Lab.). 15 Feb 1973. 25p. Dep. NTIS $3.25.

Five microwave interferometers are used to measure radial and longitudinal electron density profiles versus time in the 2X II minimum-B mirror containment experiment. The mean plasma radius determined from a radially offset interferometer agrees with electrostatic probe and laser measurements. The longitudinal profile is consistent with a collisional ion angular distribution with a density at the mirrors of ~5% of the central density. After compression, the plasma shape remains approximately constant. Plasma densities beyond the mirrors were less than 5% of the central density. (auth)

26467 DIAGNOSTICS OF HIGH-TEMPERATURE, HIGH-DENSITY PLASMA BY RADIATION ANALYSIS. Conrads, H. (Kernforschungsanlage, Juelich, Ger.). Appl. Spectrosc. Rev.; 6: No. 2, 135-138(1972).

The diagnostics of laboratory plasmas having an average particle energy of higher than 30 eV per particle and a density of greater than 10^{19} particles per cm^3 is discussed. Common features of such plasmas related to applied spectroscopy are their complete ionization, the high excitation and ionization levels of the particles, the large emission coefficients for continuum radiation over a wide spectral range from the x-ray region up to the infrared, their small size, high temperature and density gradients to the environment, and their transient nature. (auth)

26468 RESONANCE BEHAVIOR OF THE ION-SHEATH CAPACITANCE NEAR THE PLASMA ION FREQUENCY. Oliver, B. M.; Clements, R. M. (Department of Physics, University of Victoria, Victoria, British Columbia, Canada). J. Appl. Phys. 44: No. 3, 1128-1132 (Mar 1973).

A slight minimum in the measured rf capacitance of the ion sheath surrounding negatively biased planar and cylindrical Langmuir probes in a collisionless plasma has been observed. The position of the minimum, which is near the plasma ion frequency ω_i, and which closely agrees

with that predicted on the basis of simple physical arguments, is studied both as a function of plasma density and probe potential. The experimental results, for the planar probe, are compared with a recent theory by Rosa. The plasma was formed in the positive column of a helium dc discharge at a pressure of 0.3–0.5 Torr, with plasma electron densities and temperatures ranging between 10^{15} and 10^{16} m^{-3} and between 5×10^5 and 7×10^5 °K, respectively. Measurements of the sheath capacitance were made using a tunnel-diode oscillator circuit whose frequency could be adjusted approximately an order of magnitude above or below ω_i. (auth)

26469 COLLISIONAL EFFECTS ON THE TRANSIENT RESPONSE OF A CYLINDRICAL ELECTROSTATIC PROBE. Peterson, E. W. (University of Minnesota, Minneapolis, Minnesota 55455). J. Appl. Phys. 44: No. 2, 636-643 (Feb 1973).

The low-frequency response characteristics of an electron-attracting cylindrical probe operating in the transition regime are presented. The analysis is applicable for probes of arbitrary ratios of radius to Debye length operating in plasmas where the collisional effects result from electron-neutral interactions. Equations which relate the probe current fluctuations to fluctuations in the plasma properties are presented with the intent of providing an explicit formulation for data interpretation. Conditions are also defined which must be satisfied if the intensity of the electron density fluctuations are to be determined directly from probe current measurements. In addition, qualitative results are presented which describe the probe transient response when collisional effects result from electron–ion interactions. (auth)

26470 X-RAY CINEMATOGRAPHY OF A LASER-PRODUCED PLASMA. Delmare, C.; Laviron, E.; Rabeau, M.; Schirmann, D.; Tonon, G. (Centre d'Etudes de Limeil, Villeneuve Saint-Georges, France). Acta Electron.; 15: No. 4, 363-367(Oct 1972). (In French).

Microchannel-plate electron multipliers have various applications. An experiment for the x-ray cinematography of a plasma emitting radiation in the 1- to 100-A waveband is described. The advantage of the equipment described is that the spectral, spatial, and temporal resolution of the emitted x ray can be simultaneously determined. (France)

26471 ELECTROSTATIC PROBE THEORIES AND MEASUREMENTS IN FLAME PLASMAS. Bradley, D.; Ibrahim, S. M. A. (Univ. of Leeds, Eng.). J. Phys., D (London); 6: No. 4, 465-478 (28 Feb 1973).

The application of probe theories to flame plasmas is examined. For low-pressure laminar flames with small double spherical probes, the electric Reynolds number is less than unity and the theory of Su and Lam (Phys. Fluids; 6: 1479-91(1963)) is often applicable. The effect upon plasma potential of drawing current to the probes is examined experimentally, and it is shown that under certain conditions there is a significant shift of plasma potential. The effects of this upon measured values of ion concentration and electron temperature are discussed, and a correction procedure is proposed. The effects upon the measured value of electron temperature of the probe being cooled below the gas temperature are examined theoretically. (auth)

26472 MICROWAVE CAVITY MEASUREMENTS OF ELECTRON DENSITIES IN A SHOCK TUBE. Hooper, G. (University Coll. of Wales, Aberystwyth). J. Phys., D (London); 6: No. 4, 456-464(28 Feb 1973).

The use of the the microwave cavity in the study of ionization in shock waves in reactive gas mixtures is discussed. Some of the factors affecting the performance of a TE_{011} mode cavity are considered, and it is noted that the presence of end holes in the cavity and a containing tube for the plasma both lead to a considerable enhancement of the cavity sensitivity. In the light of this, some results for the recombination rate constant of the oxyacetylene reaction diluted in argon obtained in a previous study are reanalyzed and found to be in reasonable accord with those of other workers, obtained with a microwave interferometer. (auth)

26473 THEORETICAL ANALYSIS OF SPHERICAL-PROBE CHARACTERISTICS FOR COLLISIONAL PLASMA. Sharma, V.; Verma, J. S. (Birla Inst. of Tech. and Science, Pilani, India). Indian J. Pure Appl. Phys.; 10: No. 8, 619-623(Aug 1972).

The dynamic conditions in a collisional plasma fitted with an electrical probe were mathematically formulated on the basis of the kinetic theory and solved using the two-sided distribution function of Wasserstrom et al. (Phys. Fluids, 8: 56(1965)) and assuming a curved trajectory for the charged particles in their transit from the last collision to the probe surface. Solutions are obtained for a small potential on the probe and for an arbitrary potential on the probe in the quasi-neutral region. It is not possible to obtain direct solutions to the mathematical formulation in the sheath region for an arbitrary probe potential but exact solutions can be obtained using numerical analysis on a computer. For a small as well as an arbitrary probe potential, the analysis shows an increase in the value of the current and a decrease in the value of the potential compared to those reported by Wasserstrom et al. (auth)

Kinetics (General)

Refer also to abstract 24327.

26474 (AD-748180) MAGNETIC FIELD GENERATION DUE TO RADIATION PRESSURE IN A LASER-PRODUCED PLASMA. Stamper, J. A. (Naval Research Lab., Washington, DC). Aug 1972. 22p. (NRL-MR-2492). NTIS.

Magnetic field generation, according to Faraday's Law, requires a solenoidal electric field. Solenoidal electric fields associated with the large pressure and temperature gradients existing in laser-produced plasmas have previously accounted for the conversion of plasma thermal energy into magnetic field energy. It is shown that, in addition to these thermal sources, radiation pressure gradients produce a solenoidal electric field and thus provide a nonthermal (not dependent on plasma heating) source so that there is a direct conversion of laser radiation energy to magnetic field energy. This also implies a nonthermal (no plasma heating) absorption of laser radiation. (auth)

26475 (AREAEE-155) CONICAL ELECTRODE DISCHARGE. El-Khalafawy, T. A.; Masoud, M. M.; El-Gwaily, M. S.; Zemskov, A. I. (Atomic Energy Establishment, Cairo (Egypt). Dept. of Accelerators and Plasma Physics Research). 1972. 39p. Dep. NTIS (U.S. Sales Only) $4.00.

A conical electrode discharge system of 30.84-μF capacity and charged up to 10 kV was used. A discharge current of 190 kA was obtained with 10-μsec period of discharge. The Rogowsky-coil measurements showed that the current is rapidly damped, reaching zero at the third half-cycle, due to the rapid increase of the impedance of the medium to high value. The inner Rogowsky coil measurements indicated a pinch effect after 1.0 μsec and 2.5 cm from the ring electrode. The energetic electrons emitted from the discharge were detected by a Faraday cup. Such electrons (runaway electrons) ionize the medium before the passage of the shock wave. The variation of these energetic electrons with pressure showed repeated peaks with a maximum at 80 mtorr. The common light emitted from the source indicated the three-particle ionization process which is due to the existence of the impurity particle evaporated from the chamber walls. The gas used was hydrogen at a pressure ranging from 1 mtorr up to 200 mtorr. (auth)

26476 (CONF-720404(Vol.4), pp 2373-2384) EXTREME ULTRAVIOLET PROCESSES INVOLVING POPULATION INVERSION IN A DENSE LASER-PRODUCED PLASMA. Carillon, A.; Jaegle, P.; Jamelot, G.; Sureau, A. (Paris Univ., Orsay, France). Jan 1973.

From Proceedings of the international conference on inner shell ionization phenomena and future applications; Atlanta, Georgia (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

An experimental and theoretical study was made of some mechanisms involving twice excited states and able to produce inversions between levels lying in the soft-x-ray range. The spectroscopic features of an Al plasma produced by laser bombardment are discussed. (MOW)

26477 (CONF-730209-(Abstr.)) AUSTRALIAN INSTITUTE OF NUCLEAR SCIENCE AND ENGINEERING 9TH AINSE PLASMA PHYSICS CONFERENCE, LUCAS HEIGHTS, FEBRUARY 12–13, 1973; UNIVERSITY OF SIDNEY, FEBRUARY 14, 1973. (Australian Inst. of Nuclear Science and Engineering, Lucas Heights). 1973. 63p.

From 9th plasma physics conference; Lucas Heights and Sydney, Australia (12 Feb 1973).

Abstracts of sixty three papers deal with plasma diagnostics; waves and shocks; collisions, discharges and transport; shock phenomena; plasma theory; and plasma devices. (AT)

26478 (COO-3577-4) THEORETICAL RESEARCH IN THE FUNDAMENTALS OF PLASMA PHYSICS. Final Report. Bernstein, I. B. (Yale Univ., New Haven, Conn.). 1973. Contract AT(11-1)-3577. 11p. Dep. NTIS $3.00.

A wide variety of theoretical investigations have been carried out in fundamental plasma physics. These include: studies of absorption in cold plasmas, a comprehensive analysis of ion-wave

experiments, treatment of the motion of a charged particle in an electromagnetic field, derivation of geometric optics in ideal MHD, development of a snowplow model to treat the smooth expansion of a laser-produced plasma into a confining magnetic field and the stability thereof, study of the flow of a hypersonic plasma around a spherical absorber, theory of rf fields in spatially nonuniform plasmas, and theory of electron distribution functions in weakly ionized plasmas. (auth)

26479 (EUR-4938, pp 13-19) ENERGY FEEDBACK IN A HIGH AMPLITUDE TRAVELING-WAVE PLASMA ACCELERATOR. Bieger, W.; Cosler, A.; Gresser, H.; Richter, F.; Tuczek, H. (Institut fuer Plasmaphysik, Juelich, Ger.). Dec 1972.

From seventh symposium on fusion technology; Grenoble, France (24 Oct 1972).

A quasicontinuous plasma accelerator with a pulse duration up to 10 msec for the investigation of plasma wall interaction, especially for simulation experiments in fusion reactor technology has been built. The plasma is generated and accelerated by an electromagnetic traveling wave excited on an artificial line. A special feedback circuit is used to transfer as much energy as possible from a 5 MW transmitter to the plasma. This is achieved by using a suitable length of the transmission line and a transformer so that the output voltage of the line is equal to that of the input, both in phase and amplitude. The transition time of the system is about 80 μsec. With a reflection factor smaller than 5%, traveling waves with peak magnetic fields of 1.6 kG are achieved. (auth)

26480 (JAERI-M-4941) NUMERICAL CALCULATION OF THE SPACE-TIME EVALUATION OF TOKAMAK DISCHARGE PLASMAS. Tazima, T.; Takeda, T.; Itoh, S. (Japan Atomic Energy Research Inst., Tokyo). Aug 1972. 53p. (In Japanese). NTIS (U. S. Sales Only).

A two-fluid numerical model, including the effects of current penetration and thermal diffusion, is used to follow the temporal evolution of radial profiles in the Tokamak discharge plasmas. Anomalous resistivity and anomalous electron thermal conductivity are introduced in the axisymmetrical cylindrical plasma. The equations for a plasma column are solved with a Crank-Nicalson's finite-difference method. The results of calculation are in agreement with those of experiments (T-3 and ST). The possibility of a negative current density during the decreasing phase of total plasma current and the problem of estimation of the experimental energy confinement time are also discussed. (auth)

26481 (LA-5003-MS) SELF-FOCUSING IN PASSIVE MEDIA. I. Suydam, B. R. (Los Alamos Scientific Lab., N. Mex.). Mar 1973. Contract W-7405-eng-36. 21p. Dep. NTIS $3.25.

The propagation of light in a transparent, passive medium whose anamolous index of refraction is cubic in the electric field strength is studied. For finite beams, one finds that self-focusing occurs when a critical power (not power density) is surpassed, and general formulas are given from which critical power and self-focusing distances can be easily computed. Infinite beams, i.e., plane waves are always unstable and will break up into cells, each of which contains roughly twice critical power. Examples are computed from the formulas developed, and it is shown how high critical power and long self-focusing length may be attained. The attainment of very high laser power will surely be difficult, but self-focusing seems not to render it impossible. (auth)

26482 VELOCITY OF NEUTRAL ATOMS EMANATING FROM THE CATHODE OF A STEADY-STATE LOW-PRESSURE MERCURY ARC. Eckhardt, Gisela (Hughes Research Laboratories, 3011 Malibu Canyon Road, Malibu, California 90265). J. Appl. Phys. 44: No. 3, 1146-1155 (Mar 1973).

The velocity of the neutral atoms emanating from the cathode of a steady-state low-pressure mercury-arc discharge has been studied by a gravimetric-calorimetric method. The results can be interpreted in a consistent way by attributing a superthermal rms velocity of $(7.5\pm0.6)\times10^3$ m sec^{-1} to a first neutral flux component arising from cathode-spot action (and having a particle flux proportional to the arc current), and a thermal rms velocity of $(2\text{–}10)\times10^2$ m sec^{-1} to a second neutral flux component comprising particles evaporated from the spot-free mercury surface. A model is proposed and discussed which explains the origin of the fast neutrals: It is suggested that the primary particles emerging in connection with the cathode spots are essentially all ions which have gained superthermal velocities in the vicinity of the cathode spots, and that a fraction of these ions subsequently becomes neutralized retaining most or all of its energy while, on the other hand, the primary particles evaporated from the spot-free mercury surface are all neutrals. It is shown that charge-exchange collisions were sufficiently frequent under the employed experimental conditions to account for an equilibrium between the various flux components; the existence of such an equilibrium is borne out by the experiments. While the experimental method employed did not permit a measurement of the velocity distribution, it did provide sufficient evidence to conclude that the stated neutral velocities are characteristic for the two neutral fluxes in the immediate vicinity of the cathode, and that the degree of velocity equilibration between them at distances on the order of a centimeter from the cathode should depend on various experimental parameters. The two limiting cases are discussed: that either complete velocity equilibration takes place between the two neutral flux components, or none at all. (auth)

26483 STARK EFFECT AND LINE BROADENING IN THREE-DIMENSIONAL STOCHASTIC FIELDS. Kim, S. H.; Wilhelm, H. E. (Department of Physics, Colorado State University, Fort Collins, Colorado 80521). J. Appl. Phys. 44: No. 2, 802-810 (Feb 1973).

A theory is given for (i) the linear Stark effect of the substates of the first excited level of the hydrogen atom and (ii) the linear Stark broadening of the Lyman α line, in a three-dimensional stochastic electric field. The latter is represented in the form of a three-dimensional Fourier series with different random amplitudes and random phases for each vector component of the wave modes, which simulates a perturbing vector field varying with respect to intensity and direction in a random manner during an atomic transition. The line-shape broadening; lyman lines; hydrogen; plasma; turbulence; electric fields; function, which is a moment of the distribution function of the random amplitudes and random phases of the stochastic field, is evaluated by statistical methods. It is shown that the Lyman α line consists of a sequence of discrete spectra (Fourier analysis) at the frequencies $\omega=n\omega_p$, $n=0,\pm1,\pm2$, etc. frequency. The line intensity decreases exponentially with the square of the order number n. The half-width of the spectral line is proportional to the square root of the mean square stochastic electric field. In the case of electron acoustic turbulence, the half-width is related to the unperturbed electron pressure. These results permit a quantitative determination of the intensity of the stochastic electric field and the average electron pressure in turbulent plasmas. (auth)

26484 IONIZATION, RECOMBINATION, AND POPULATION OF EXCITED LEVELS IN HYDROGEN PLASMAS. Johnson, L. C.; Hinnov, E. (Princeton Univ., NJ). J. Quant. Spectrosc. Radiative Transfer; 13: No. 4, 333-358(Apr 1973).

Transition rate equations for atomic hydrogen are solved to obtain coefficients for population of excited levels and for ionization and recombination. The results are based upon more accurate transition rates, cover a wider range of plasma parameters (electron density, ion density and electron temperature), and are obtained by a more general solution of the rate equations than previously available compilations. Diagnostic applications for laboratory plasmas are discussed. (auth)

26485 ION TEMPERATURE AND STEADY-STATE CHARACTERISTICS OF A LOW-DENSITY MAGNETOPLASMA COLUMN. Oktay, E.; Robinson, J. E. (Massachusetts Inst. of Tech., Cambridge). Plasma Phys.; 15: No. 3, 227-241(Mar 1973).

Theory and experimental results are presented for the ion temperature and the steady-state characteristics of a low density magnetoplasma column. An argon plasma column was generated using a Lisitano structure with 10 to 50 W of 2.8 GHz power. This method of plasma production results in radially varying end losses and radial transport related to ion perpendicular mobility and ion viscosity. Ion temperature is derived from an approximate transport theory and experimentally verified by measuring the Doppler broadening of argon II 4610-Å radiation. (auth)

26486 TRANSITION OF HYDROGEN INTO THE METALLIC STATE IN A COMPRESSION WAVE INDUCED BY A LASER PULSE. Anisimov, S. I. (Inst. of Theoretical Physics, Moscow). JETP Lett. (USSR) (Engl. Transl.); 16: No. 10, 404-406(20 Nov 1972).

Translated from Zh. Eksp. Teor. Fiz., Pis'ma Red.; 16: No. 10, 570-572.

It is shown that the pressures needed for the transition of hydrogen into a metallic state can be attained by irradiating a hydrogen target with a laser pulse of special waveform. The waveform of the pulse is determined and the pulse parameters in the target are estimated. (MOW)

26487 COMPARISON BETWEEN PLASMA INJECTORS WITH CAPACITIVE AND INDUCTIVE ENERGY STORAGE. Belan, N. V. Samoletostr. Tekh. Vozdush. Flota; No. 28, 30-34(1972). (In Russian).

A system of equations is derived and solved that describes the plasma-beam acceleration process in plasma injectors with capacitive and inductive energy storage. The equations are obtained under the assumption that the opening of the charging circuit occurs instantaneously. Comparison criteria are introduced, and the effectiveness of the acceleration process in these injectors is compared. (IAA)

26488 PLASMA PHYSICS INDEX. Thesaurus 1973. Leopoldshafen, Ger.; Zentralstelle fuer Atomkernenergie-Dokumentation (1973). 21p.

Kinetics (Experimental)

26489 (CONF-720404-(Vol. 1), pp 430-435) DIELECTRONIC RECOMBINATION IN LASER-PRODUCED PLASMAS LEADING TO ABNORMAL INTENSITIES OF SOME EMISSION LINES. Sureau, A. (Paris Univ., Orsay, France). Jan 1973.

From International conference on inner shell ionization phenomena and future applications; Atlanta, Georgia, USA (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

The comparison between the relative transition probabilities of some emission lines and the relative abilities of their corresponding initial states to interact with autoionizing excited states can explain the discrepancies between normally predicted intensities and those observed in the hot and dense zone of a laser-produced plasma. (auth)

26490 (IAE-2077) MEASUREMENT OF CONDUCTIVITY DISTRIBUTION ALONG PLASMA PINCH CROSS SECTION. Ivanov, D. P.; Leneva, A. E.; Parfenov, D. S. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow. Institut Atomnoi Energii). 1971. 11p. (In Russian). INIS.

Distributions of the harmonics of the variable current along the plasma pinch cross section were calculated, the conductivity of which is a given function of the radius. The relation of the voltage, exciting the current harmonics, to the derivative of this current was calculated in dependence on its frequency. The possibility of experimental determination of the distribution profile of the conductivity in the plasma pinch by comparison of the calculated curve with the results of measurement is discussed. (tr-auth)

26491 DEVICE FOR MEASURING THE INSTANTANEOUS VALUE OF CURRENT AND VOLTAGE IN THE OPERATION OF A PULSED PLASMA ACCELERATOR. Belan, N. V.; Litinskii, A. T.; Pimkin, V. A. Samoletostr. Tekh. Vozdush. Flota; No. 29, 61-68(1972). (In Russian).

Digital test equipment for measuring instantaneous values of pulse current and voltage in a pulsed plasma accelerator during single-pulse operation is described. The voltage and current at any point of the pulse waveform can be sampled by using an adjustable delay circuit to trigger a gating pulse that enables sampling through a controlled switching element. The signal at the output of the gated switch is checked for polarity and converted into a sequence of pulses for subsequent processing that ensures high readout precision. (IAA)

26492 EXPERIMENTAL OBSERVATION OF T LAYERS IN A MOVING PLASMA INTERACTING WITH THE MAGNETIC FIELD. Zakharov, A. I.; Klavdiev, V. V.; Pismennyi, V. D.; Rothardt, L.; Saenko, V. B.; Starostin, A. N.; Yan, G. (Moscow State Univ.). Phys. Lett., A; 43A: No. 2, 187-188(26 Feb 1973).

Experimental results are presented of a study of the interaction of plasma bunches injected from an independent source into a parallel-plate rail tube with the magnetic field decelerating their motion. A process of the formation of the stratified plasma structure regular in character was detected. (auth)

Kinetics (Theoretical)

26493 (AD-748587) TWO-DIMENSIONAL HARD CORE THETA PINCH OBSERVATIONS OF SPIRAL STRUCTURE ASSOCIATED WITH INITIAL BREAKDOWN. Cuchs, D.; Dixon, R. H.; Elton, R. C. (Naval Research Lab., Washington, DC). 26 Jul 1972. 8p. (NRL-MR-2495). NTIS.

The evolution of the luminous plasma structure in a hard core theta-pinch was studied in two dimensions (r,z). Distinct plasma spirals around the hard core are formed. In the antiparallel (B_z)-bias case the spirals coalesce due to a 3:1 axial compression. With zero bias field the plasma filaments are spiraling in the opposite sense of rotation. An axial structure of the plasma is observed to be present at the beginning of the discharge. In the theta-pinch without hard core this structure is shown to originate in the very initial preheater breakdown. (auth)

26494 (AD-750715) RESEARCH ON PLASMA SIMULATION BY COMPUTER FOR STUDIES OF COLLISIONLESS SHOCKS AND PLASMA TURBULENCE. Final Report. Dawson, J. M. (Princeton Univ., N. J. Plasma Physics Lab.). Nov 1972. 5p. NTIS.

The research dealt with the development of numerical techniques for simulating plasmas and the application of these techniques to solve important problems on the nonlinear and turbulent behavior of plasmas. A number of significant problems were solved on the anomalous absorption of intense radiation by plasma, and on the anomalous diffusion of plasma across a magnetic field. (auth)

26495 (NP-19700) COMPARISON OF TOROIDAL SCREW PINCH EXPERIMENTS WITH ONE-DIMENSIONAL MHD COMPUTER CALCULATIONS. Van der Laan, P. C. T.; Nijsen-Vis, A.; Kooyman, W. (Stichting voor Fundamenteel Onderzoek der Materie, Jutphaas (Netherlands). Instituut voor Plasma-fysica). Dec 1972. 18p. Dep. NTIS (U.S. Sales Only) $3.00.

The low-density plasma which surrounds the central column in a pinch discharge may carry considerable currents, especially when end effects are absent as in toroidal configurations and in one-dimensional MHD computer codes. These currents tend to conserve the pitch of inward-moving helical field lines and provide thereby a correlation between the pitch history at the wall and the pitch distribution built up in the tube. The field and pitch distributions measured in a toroidal screw-pinch device are compared to the field and pitch distributions calculated by means of the Culham one-dimensional MHD code. This comparison, which is made for five different programings of the applied fields, shows a fair agreement in the outside region. To derive the pitch from the measured field components it is necessary to find the location of the displaced toroidal magnetic surfaces. The origin of the low-density plasma is discussed as well as the possible role of anomalous resistivity. (auth)

26496 (UCID-15979) CALCULATION OF PLASMA CURRENTS GENERATED BY THE E-LAYER DURING ITS INJECTION AND FORMATION PHASE. Christofilos, N. C. (California Univ., Livermore. Lawrence Livermore Lab.). 24 Nov 1971. 11p. Dep. NTIS $3.00.

A quantitative calculation is presented of plasma currents. All the quantities are derived as a function of an azimuthal electric field varying with time as $e^{i\omega t}$. Calculations of the electric field as a function of E-layer current are given. (MOW)

26497 (UCID-16121) FORM OF THE CASCADE SOLUTION. Hiskes, J. R. (California Univ., Livermore. Lawrence Radiation Lab.). 1 Sep 1972. 16p. Dep. NTIS $3.00.

The observation of collisional excitation and Lorentz ionization of the excited levels (inverted cascade) in the neutral beam of the BB II experiments has prompted discussion of the mathematical form of the ion-density-buildup equation. Consideration is given here to the different approximations for the cascade term appropriate to the respective ion-density ranges. The form for the solution of the ion density versus time is approximated by different functions in different density ranges. Both the form of the solutions and the asymptotic density dependences are functions of the relative importance of charge exchange and multiple scattering. (MOW)

26498 (UCID-16133) FORMATION OF NON-MAXWELLIAN VELOCITY DISTRIBUTIONS. Bodner, S. E. (California Univ., Livermore. Lawrence Livermore Lab.). 23 Oct 1972. Contract W-7405-eng-48. 7p. Dep. NTIS $3.00.

Homogeneous electrostatic 1-D and 2-D particle simulation codes were used to study the absorption of laser light by plasma instabilities. It is demonstrated that simulations with periodic spatial boundary conditions overestimate the formation of high-energy non-Maxwellian distributions. The use of accurate 2-D spatial boundary conditions in future simulations is emphasized. (MOW)

26499 RESOLUTION OF THE BOLTZMANN EQUATION OF A LORENTZ PLASMA IN THE PRESENCE OF AN ALTERNATING ELECTRIC FIELD AND A CONSTANT MAGNETIC FIELD. Draganu, M. (Univ., Cluj). An. Univ. Cucuresti, Mat.-Mec.; 20: No. 1, 57-74(1971). (In French).

The calculations of Jancel and Kahan (J. Phys. Radium, 20: 35-42(1959)) on a plasma in the presence of an alternating electric field and a uniform magnetic field are restudied, using a development of spherical harmonics. The formulas established are identical to those previously published by Jancel and Kahan. (JSR)

26500 STATIONARY REGIMES OF STRONG-CURRENT RADIATIVE PINCH DISCHARGE IN PLASMA. Dorodnitsyn, V. A.; Popov, Yu. P. Zh. Vychisl. Mat. i Mat. Fiz.; 13: No. 1, 247-253 (1973). (In Russian).

Stationary high-current discharges in a plasma were examined

within the framework of a one-dimensional MHD model. The plasma consisted of two coaxial zones: in one zone an approximation of nonlinear thermal conductivity was applied; in the other, a spatial luminescence. At fixed parameters of the problem (full current, mass of plasma discharge, given properties of the substance) the solution was not unique. A single-parameter system of steady-state solutions was shown to exist. Analytical solutions were formulated, and were realized numerically by conversion to an asymptotic regime in the appropriate nonsteady-state problem. (tr-auth)

26501 KINETIC THEORY OF A TWO-DIMENSIONAL MAGNETIZED PLASMA. Part 2. Balescu–Lenard Limit. Vahala, G. (Univ. of Tennessee, Knoxville). J. Plasma Phys.; 8: No. 3, 357-374(Dec 1972).

The kinetic theory of a two-dimensional one-species plasma in a uniform dc magnetic field is investigated in the small plasma parameter limit. The plasma consists of charged rods interacting through the logarithmic Coulomb potential. The energy transfer from a test particle to an equilibrium plasma is discussed and shown to be zero in the long-time average limit. This supports the unexpected result of zero Balescu–Lenard collision term. (auth)

26502 NEW EXPRESSION FOR THE PARTITION FUNCTION OF A TWO-DIMENSIONAL CLASSICAL PLASMA. Lavaud, M. (CNRS, Orleans-la-Source, France); Deutsch, C. Phys. Lett., A; 43A: No. 2, 193-194(26 Feb 1973).

A new expression is derived for the canonical partition function Q of a two-dimensional Coulomb system. As a by-product, Q is shown to exist above the critical temperature T_c for the collapse of a pair of opposite point charges. (auth)

26503 EXACT HELICAL WAVE SOLUTION TO THE EQUATIONS OF MAGNETOHYDRODYNAMICS. Woolley, M. L. Plasma Phys.; 15: No. 2, 89-97(Feb 1973).

An exact solution to the equations of motion of an ideally conducting medium, in the magnetohydrodynamic approximation, is obtained. The solution describes the propagation of a helical magnetosonic wave parallel to the direction of a uniform magnetic field and the relevance of the solution to magnetospheric studies is discussed. (auth)

26504 EQUATIONS DESCRIBING A QUASI-NEUTRAL PLASMA OF HEAVY IONS CONFINED IN A MAGNETIC FIELD. Application to Ion Sources. Tauth, T. (Univ., Lyon). Nucl. Instrum. Methods; 107: No. 2, 293-300(1973). (In French).

Two methods, based on the analysis of macroscopic phenomena are described. The first one describes the evolution of elementary processes in an isolated plasma containing multicharged heavy ions and the second one, derived from the equations of MHD and electrodynamics, leads to the calculation of some characteristics of the discharge column. By means of these formalisms, one can express some of its parameters and appreciate the relation between the structure of the plasma and the magnetic field of confinement. (auth)

26505 NONLINEAR THEORY OF INTERACTION BETWEEN A MONOENERGETIC BEAM AND DENSE PLASMA. Ivanov, A. A.; Parail, V. V.; Soboleva, T. K. (Inst. of Atomic Energy, Moscow). Zh. Eksp. Teor. Fiz.; 63: No. 5, 1678-1685(Nov 1972). (In Russian).

Partial numerical simulation is used for investigation of interaction between an electron monoenergetic beam and a dense collisional plasma. The parameters of the plasma–beam system are such that the collision frequency in the plasma is greater than the hydrodynamic increment of a collisionless plasma and smaller than the plasma electron frequency. It is shown that, in the linear-interaction stage, unstable oscillations arise in the plasma and lead to partial capture of beam particles. The nonlinear interaction stage is characterized by the appearance of thermal spread in the initially monoenergetic beam which prevents development of instability; consequently, the beam readily passes through the plasma without any significant energy losses. (auth)

26506 RELAXATION PROCESSES IN A PARAMETRICALLY UNSTABLE PLASMA. Silin, V. P. (Lebedev Inst. of Physics, Moscow). Zh. Eksp. Teor. Fiz.; 63: No. 5, 1686-1697(Nov 1972). (In Russian).

A theory of relaxation of particle distributions is developed for a plasma in the strong electric field of a high-frequency pumping wave under conditions of development of parametric instability with respect to potential perturbation buildup. The possibility of increasing the number of ions with energies exceeding the electron oscillation energy in the field of the pumping wave by $(m_i/m_e)^{1/3}$ times is demonstrated. The relation between the growing ion energy and the field-perturbation energy density is established for conditions of increase of the plasma fluctuation field. High-frequency harmonics of the electron velocity distribution are produced, the electron energy spread being determined by the plasma fluctuation energy density per electron. The causes of anisotropy of the particle velocity distribution are established; the anisotropy is manifest in an anisotropy of the temperature and in possible regions of resonance relaxation. (auth)

Production

26507 (FRNC-TH-225) EXPANSION OF A PLASMA CREATED BY IRRADIATING A SOLID TARGET WITH A LASER BEAM. Bruneteau, J. (Paris Univ., Orsay (France)). 1970. 94p. (In French). INIS.

Thesis.

The expansion of a plasma created by irradiating Al targets (in the bulk metal or thin foil state) was studied. A Mach–Zehnder interferometer was used for the diagnostics. This form of interferometer enabled the plasma to be observed during time intervals not exceeding 150 ns in the absence of a magnetic field, this limitation being due to the rapid drop in density occurring during the expansion. With a magnetic field of some dozen kilogauss, it was possible to carry out investigations with times up to 250 ns, the only limitations arising from the difficulties encountered in achieving a sufficiently long optical delay. It was possible to examine the form of the plasma and to measure its electron distribution. The results are compared with measurement made by collectors which introduces a considerable time delay. Another investigation was undertaken to measure the number of electron charges in the plasma as a function of the laser energy in the focal patch. In this way, the disintegration of the target as a function of energy was determined. The behavior of the plasma in a uniform magnetic field (up to 60 kilogauss) was also examined. (auth)

26508 (UCID-16164) INITIAL HEATING RATE OF A DROPLET IN A SPHERICAL MICROWAVE CAVITY. Garelis, E. (California Univ., Livermore. Lawrence Livermore Lab.). 20 Nov 1972. Contract W-7405-eng-48. 31p. Dep. NTIS $3.75.

The problem assumes a spherical cavity with superconducting walls with a droplet of fuel material placed at the center of the cavity. The cavity is assumed to contain on the order of a megajoule of 1-cm rf energy with a cavity radius of the order of a meter. The problem is to estimate the heating rate of the droplet. A detailed calculation of the heating rate of the droplet is a formidable task. Only the initial heating rate is considered. The initial heating rate is based on the value of the Poynting vector integrated over the surface of the droplet. The necessary electric and magnetic fields are obtained by solving for the eigenfunctions of a spherical wave equation. The modes for a homogeneous spherical cavity are well known, and the extension to the present case with a central fuel droplet is relatively straightforward. (auth)

26509 PULSED METALLIC-PLASMA GENERATORS. Gilmour, A. S. Jr.; Lockwood, D. L. (State Univ. of New York, Buffalo). Proc. IEEE (Inst. Elec. Electron. Eng.); 60: No. 8, 977-991(Aug 1972).

A pulsed metallic-plasma generator is described that utilizes a vacuum arc as the plasma source. The arc is initiated on the surface of a consumable cathode, which can be any electrically conductive material. Ignition is accomplished by using a current pulse to vaporize a portion of a conductive film on the surface of an insulator separating the cathode from the ignition electrode. The film is regenerated during the ensuing arc. Over 10^8 ignition cycles were accomplished by using four 0.125-in (0.318-cm) diameter zinc cathodes operating in parallel and high-density aluminum-oxide insulators. A plasma consisting of cathode material is emitted at the rate of about 10^{-7} kg for each coulomb of charge emitted. The plasma is ejected in the form of a high-velocity highly directional conical plume through a ring-shaped anode. One or more magnetic-field coils may be used to control the impedance and the direction of the plume. The normal pulsed operating parameters for the generator are a few hundred volts and a few hundred amperes with pulse widths ranging from 50 to 500 μs and repetition frequencies up to 300 pulses per second. Among the applications being investigated for the generator are metal deposition, vacuum pumping, electric propulsion, and high-power dc arc interruption. (180 references) (auth)

26510 OBSERVATION OF A CORE IN AN EXPLODED LITHIUM WIRE PLASMA BY REFLECTION OF LASER LIGHT. Leonard, T. A. (University of Michigan, Ann Arbor, Michigan 48103). J. Appl. Phys. 44: No. 3, 1380-1381 (Mar 1973).

A thin lithium wire which was extruded and exploded in vacuo was probed with a Q-switched ruby laser. Strong reflections of the ruby laser light were observed from a "core" in the plasma when the pressure was greater than 5×10^{-4} Torr. Changes in the plasma and discharge properties near this pressure suggested the possibility of a core of unvaporized wire due to current shunting through the surrounding air. The presence of this core was unexpected because of the relatively large discharge current and small wire diameter. When the pressure was below 5×10^{-4} Torr a "core" was never observed and there was no evidence of current shunting. (auth)

26511 FORMATION OF IONIZATION CHANNEL IN HIGH-PRESSURE GAS USING PULSED RELATIVISTIC ELECTRON BEAM. Hammer, D. A.; Kapetanakos, C. A.; Ury, M. (Naval Research Laboratory Washington, D. C. 20390). J. Appl. Phys. 44: No. 3, 1121-1127 (Mar 1973).

The formation of an ionization channel in a high-pressure gas using a 10^9-W 50-nsec pulse of 500-keV electrons has been investigated. A 3-kA electron beam was injected into air, hydrogen, and helium at pressures ranging from 0.2 to 600 Torr in the presence of applied magnetic guide fields ranging up to 6 kG. It was found that the resultant beam-spreading data can be explained on the basis of elastic scattering, and that magnetic fields of a few kG can be expected to effectively control beam spread in hydrogen (and helium) up to 2 atm. Rapid loss of the plasma after the passage of the beam was observed and has been interpreted to be the rapid recombination of a very cold plasma left behind by the beam. This mechanism appears to be an attractive alternative to laser preionization of a long high-pressure Z pinch experiment. (auth)

26512 PRODUCTION OF ALKALI PLASMA BY PHOTOIONIZATION. Liebermann, M. A.; Berg, T.; Luksenberg, M. (Univ. of California, Berkeley). Rev. Sci. Instrum.; 44: No. 1, 35-37 (Jan 1973).

Pulsed, low-temperature, alkali plasmas were produced by photoionization of the vapor using a xenon flashtube uv source. Results are as follows: for cesium, $n_e > 10^{11}$ cm^{-3} with 100% ionization; for potassium, $n_e \approx 10^{10}$ cm^{-3} with 2% ionization; and for lithium, $n_e \approx 2\times10^{10}$ cm^{-3}. The flashtube spectrum in the 2100 to 3200 Å range was measured. (auth)

Stability

Refer also to abstract 26561.

26513 (AD-748985) EFFECT OF A SURROUNDING GAS ON MHD INSTABILITIES IN A Z-PINCH. Manheimer, W.; Lampe, M.; Boris, J. (Naval Research Lab., Washington, DC). Aug 1972. 39p. (NRL-MR-2485). NTIS.

The effect of an ionized or unionized background on MHD instabilities in a z-pinch is considered. It is shown that the growth rate may be reduced by at least one or two orders of magnitude even though the background pressure is very small compared to the pinch pressure. The stabilizing effect of launching shocks in the background gas is considered qualitatively. It is shown that it is possible to construct equilibria such that the Lawson condition can be satisfied. Also, it is shown that lighting discharges are stabilized by the presence of the background atmosphere. (auth)

26514 (AD-750138) SECOND-ORDER EFFECTS IN THE WEIBEL INSTABILITY. Technical Report, January-June 1972. Taggart, K. A.; Godfrey, B. B.; Rhoades, C. E. Jr. (Air Force Weapons Lab., Kirtland AFB, N. Mex.). Sep 1972. 17p. (AFWL-TR-72-162). NTIS.

An expression is derived for the coupling of two purely growing transverse Weibel modes in second order to give rise to a single electrostatic longitudinal mode. Comparison with numerical experiments shows agreement to within 5% for the magnitude and phase of the coupling. It is found that this mechanism does not contribute significantly to saturation of the instability. (auth)

26515 (AD-750477) LOW-FREQUENCY INSTABILITIES IN INHOMOGENEOUS MAGNETOPLASMA. Final Report, June 1, 1971-May 31, 1972. Self, S. A.; Crawford, F. W. (Stanford Univ., Calif. Inst. for Plasma Research). Jun 1972. Contract F44620-71-C-0076. 19p. (SU-IPR-483; AFOSR-TR-72-2006). NTIS.

The research covers hollow cathode discharge (HCD) mechanisms and instabilities. Positive column theories of steady state magnetized discharges are extended to finite cylinder geometries by separation of variables. Low frequency instabilities in HCD's are identified as centrifugal flute modes driven by nonuniform E/Br rotation and stabilized by infinite Larmor radius effects. (auth)

26516 (AD-750478) LOW-FREQUENCY FLUTE INSTABILITIES OF A HOLLOW-CATHODE ARC DISCHARGE: THEORY AND EXPERIMENT. Ilic, D. B.; Rognlien, T. D.; Self, S. A.; Crawford, F. W. (Stanford Univ., Calif. Inst. for Plasma Research). Jul 1972. Contract F44620-71-C0076. 49p. (SU-IPR-482; AFOSR-TR-72-2009). NTIS.

The characteristics of two low-frequency electrostatic flute instabilities of a low-pressure hollow-cathode arc discharge are reported. Mode 1 has azimuthal mode number m = 1, and occurs when the radial electric field is negative (directed inwards) while Mode 2 has m = -1 and occurs when the field is positive. The radial electric field is controlled by varying the potential of a secondary anode cylinder located close to the outer discharge radius. A linear perturbation analysis, based on the two-fluid equations, is given for a low-beta, collisionless cylindrical plasma column, immersed in a uniform axial magnetic field, and having a Gaussian density profile and an arbitrary radial electric field profile. Reasonable correlation between theory and experiment is demonstrated for both modes, by comparing the calculated and measured frequencies, mode numbers, and also the eigenfunctions of the density and potential fluctuations. (auth)

26517 (IPP-IV-14) INVESTIGATION OF IONIZATION INSTABILITY IN AN ARGON-POTASSIUM PLASMA IN CROSSED ELECTRIC AND MAGNETIC FIELDS. Riedmueller, W. (Max Planck-Institut fuer Plasmaphysik, Garching (West Germany)). Mar 1971. 73p. (In German). Dep. NTIS (U.S. Sales Only) $5.75.

The development of ionizational instability in a streaming, weakly ionized argon-potassium plasma in which several discharges burn parallel to the gas flow and across an applied magnetic field is investigated by means of time- and space-resolved measurements of the electric field, electron density, and electron temperature and by means of image-converter pictures. Special importance is placed on producing as homogeneous a plasma as possible (at least in the time average). It is shown that three effects have to be taken into account: short-circuiting of the Hall field at both ends of the discharge, influence of the Lorentz force, and convective constriction of the discharge at the channel entrance. When the Hall parameter exceeds a certain value, a characteristic striated structure appears. The critical Hall parameter and the phase velocity of the striations can readily be explained in terms of the known theory of the ionizational instability. On the other hand, the theory has to be elaborated to account for the complicated structure at higher Hall parameters and for the observed wavelengths and frequencies. For this purpose a method is developed by means of which allowance can be made analytically for the influence of dissipation due to thermal conduction and radiation processes and for the boundary conditions. (auth)

26518 (JAERI-M-4890) NUMERICAL ANALYSIS OF THE MAGNETOHYDRODYNAMIC INSTABILITIES OF CYLINDRICAL AND TOROIDAL PLASMAS BY THE FINITE ELEMENT METHOD. Takeda, T.; Shimomura, Y.; Ohta, M.; Yoshikawa, M. (Japan Atomic Energy Research Inst., Tokyo). Jul 1972. 44p.

A finite-element method is proposed for stability analysis of a cylindrical current-carrying plasma embedded in a strong longitudinal magnetic field. These results of numerical analyses will be published in separate papers. The purpose of the present report, which supplements and is in considerable duplication with the subsequent papers, is twofold. That is, all the results obtained thus far are summarized. The procedures of analyses are then given both in detail and comprehensively, to serve as a manual for users of the computer program. Furthermore, the formulation is described for another computer program being prepared at present for stability analysis of toroidal current-carrying plasmas in general. (auth)

26519 (LRP-58/72) MECHANISM OF HELICOIDAL PINCH STABILIZED BY FEEDBACK. Keller, R. (Centre de Recherches en Physique des Plasmas, Lausanne (Switzerland)). Dec 1972. 32p. (In French). Dep. NTIS (U.S. Sales Only) $3.75.

A rectangular helicoidal pinch in which the extremities are maintained rigidly by electrodes is considered. Only the modes m = 1 (kink mode) are studied in the following approximations: plasma diameter small compared with wave lengths and external wall diameter, perfectly conducting plasma, and linearized movement equations. The method consists in a Fourier analysis of the deformation of the plasma as well as of the feedback force projected in a helicoidal referential. The questions of dephasing and coupling are discussed. The first longitudinal mode is stabilized far above the Kruskal-Shafranov limit. It was observed that there exists a magnetic structure permitting the simultaneous stabilization of two modes. (tr-auth)

26520 (NIIEFA-T-158) DYNAMIC STABILIZATION OF TOROIDAL DISCHARGE IN LONGITUDINAL MAGNETIC FIELD.

Vasilevskii, M. A.; Roife, I. M.; Seredenko, E. V. (Scientific Research Inst. of Electro-Physical Apparatus, Leningrad (USSR)). 1972. 15p. (In Russian). INIS.

The instability of a toroidal discharge with a quasi-constant and high-frequency current in a longitudinal magnetic field was investigated in the "Toloskop" apparatus. Under the conditions of the experiment, high-frequency stationary oscillations of a plasma filament of small radius occurred. Results of experimental determination of the limits of the region of stability are compared with values obtained for the dynamic stabilization of a plasma column undergoing such oscillations. (tr-auth)

26521 (NP-19697) EQUILIBRIUM OF A WEAKLY TOROIDAL PLASMA COLUMN SURROUNDED BY A TRKAL-FIELD. Schuurman, W. (Stichting voor Fundamenteel Onderzoek der Materie, Jutphaas (Netherlands). Instituut voor Plasma-Fysica). Dec 1972. 10p. Dep. NTIS (U.S. Sales Only) $3.00.

The toroidal shift of a weakly toroidal plasma column surrounded by a tenuous plasma in a Trkal-field and by a metal wall is calculated. Comparison is made with similar calculations for a plasma column surrounded by either a vacuum or a tenuous plasma in a magnetic field with constant pitch. (auth)

26522 (TRITA-EPP-72-28) CENTRIFUGAL EXPANSION INSTABILITY OF A ROTATING PLASMA. Lehnert, B. (Kungliga Tekniska Hogskolan, Stockholm (Sweden)). Dec 1972. 25p. Dep. NTIS (U.S. Sales Only).

Research on rotating plasmas does not merely produce results of interest to a limited class of plasma devices, but provides an important tool for general studies of high-beta plasma stability. The high thermal pressure of a hot plasma can namely be simulated by the large centrifugal force of a dense rotating plasma, thus giving rise to equivalent beta values β_c exceeding 0.1 in simple laboratory experiments. The following associated problems are treated. (1) The relations between β_c and the induced azimuthal plasma currents and radial "expansions" of the magnetic field lines are determined in terms of simple models of the induced current distribution. (2) A "centrifugal expansion instability" is shown to exist at sufficiently high beta values and for long axial lengths of the plasma confinement region. This mode is of ballooning and collective character, being somewhat related to the mirror instability. (3) The centrifugal expansion instability provides a possible explanation of the earlier observed anomalous plasma behavior in the device F III. (SW)

26523 (UCID-16217) SUPPRESSION OF THE HOSE INSTABILITY WITH A SOLENOIDAL FIELD. Gladd, N. T.; Lee, E. P. (California Univ., Livermore. Lawrence Livermore Lab.). 5 Feb 1973. Contract W-7405-eng-48. 16p. Dep. NTIS $3.00.

The theory of the resistive hose instability of an unmodulated electron beam is modified to include the effect of a solenoidal field B_z applied along the axis of propagation. In the strong-field limit, the peak spatial growth rate is reduced by a factor of approximately k_β/k_c compared with a beam having the same dimension and no applied field. k_β and k_c are the particle betatron and cyclotron wave numbers. (auth)

26524 (UNICP-SR-95) LITERATURE SURVEY ON PLASMA INSTABILITIES COVERING 1971 PUBLICATIONS. Part 2. Abstracts. Auer, G.; Cap, F.; Shukla, P. (Innsbruck Univ. (Austria). Institut fuer Theoretische Physik). 31 Dec 1972. 304p. Dep. NTIS (U. S. Sales Only) $17.25.

This report covers abstracts on publications concerned with plasma instabilities which were published during the calendar year 1971. The following indices are given: (1) name of instability—abstract number, and (2) list of all references, ordering according to periodical. (MOW)

26525 LOCALIZED DRIFT-DISSIPATIVE MODES IN TOKAMAKS. Adam, J. C.; Laval, G.; Pellat, R. (CEN, Fontenay-aux Roses, France). Nucl. Fusion; 13: No. 1, 47-53(Jan 1973).

The collisional trapped-electron instability in tokamak-like configurations is studied. In this experiment, where the electron collision frequency is not much smaller than the trapped-electron bounce frequency, the frequencies of the important modes are larger than the ion bounce frequency. Taking the geodesic curvature of magnetic lines into account and introducing a radial wave number, it is possible to show the existence of modes which are localized along the field lines and not affected by shear. The role of circulating electrons is analysed in greater detail. The growth rates are computed by solving a Fokker–Planck equation numerically. In this case, the domain of validity of the results is enlarged. A precise value of the limiting collision frequency, below which the electron temperature gradient stabilizes the mode, is obtained. Finally, for small aspect ratio, a collisionless instability due to magnetic drift resonances of electrons is found. (auth)

26526 SATURATION OF A CONVECTIVE INSTABILITY DUE TO TRAPPED PARTICLES. Boyd, D.; Bollinger, D.; Carr, W.; Liu, H.; Seidl, M. (Stevens Inst. of Tech., Hoboken, NJ). Phys. Lett.; 43A: No. 1, 45-46(12 Feb 1973).

The saturation of a single wave ($\omega > \omega_{ce}$) spatially growing due to interaction with a cold electron beam in a magnetoplasma is studied. A wavelength change after saturation is observed. (auth)

26527 DRIFT-LIKE INSTABILITY IN DENSITY MODULATED PLASMAS IN A STATIC MAGNETIC FIELD. Croci, R.; Saison, R. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). Phys. Lett.; 43A: No. 1, 71-72(12 Feb 1973).

In addition to the usual drift mode, a density-modulated plasma in a static magnetic field will sustain a "modulation" mode if $\lambda_{Debye} > R_{i\,Larmor}$. The wave remains unstable even for $|k_y R_i| \ll 1$. (auth)

26528 DISPERSION EQUATIONS OF A PLASMA WITH TWO OPPOSED CURRENTS. Draganu, M. (Univ., Cluj). An. Univ. Becucuresti, Mat.-Mec.; 18: No. 2, 27-36(1969). (In French).

The instabilities of an infinite totally ionized plasma, constituted of electrons and protons, with the diffusion of each species being controlled by a Boltzmann–Vlasov equation without shock term and unidimensional with respect to position and velocity were previously considered. In the present study, the same hypotheses were made on the state of the plasma but the effect of collisions was introduced in the diffusion equations by using the relaxation times. The only force field is the self-consistent electric field determined by the Poisson equation which corresponds to the two components of the plasma. In the second part, the instabilities of the two beams are considered in the presence of an applied constant magnetic field. Only those perturbations being propagated in the direction of the applied magnetic field are considered. (tr-auth)

26529 INSTABILITY OF LONGITUDINAL OSCILLATIONS IN AN INHOMOGENEOUS ISOTROPIC PLASMA. Demchenko, V. V.; El Naggar, I. A. (Atomic Energy Establishment, Cairo). Czech. J. Phys.; 22: No. 11, 1194-1198(1972).

The stability of forced nonlinear longitudinal oscillations in isotropic plasma is investigated. It is demonstrated that at a certain ratio between the parameters of the plasma and the external force there arise parametric-like instabilities, and both harmonics and subharmonic oscillations of the order of $\frac{1}{3}$ become unstable. The growth rate of the unstable oscillations and conditions under which they occur are defined. (auth)

26530 SOME STATIONARY SOLUTIONS OF EQUATIONS FOR IONIZATION INSTABILITY OF PLASMA. Taranov, V. B. (Inst. of Electrodynamics, Kiev). Dopov. Akad. Nauk Ukr. RSR, Ser. A; No. 11, 1039-1041(Nov 1972). (In Ukrainian).

The symmetry of equations of the simplest physical model of ionization instability is studied in the stationary case. Some exact solutions are obtained and possibilities of matching them are discussed. (auth)

26531 OPTIMAL STABILIZATION OF THE RAYLEIGH-TAYLOR INSTABILITY IN THE MULTIARM FLUID PENDULUM. Zrnic, Dusan S. (School of Engineering, San Fernando California State University Valley State College, Northridge, California, 91324). J. Appl. Phys. 44: No. 2, 883-886 (Feb 1973).

This work poses the control of an instability in the multiarm fluid pendulum as an optimal regulator problem. A linear set of equations describing the motion of fluid in the pendulum is developed and the analytical solution of the control problem is presented. An experiment of optimal stabilization on a two-arm pendulum is discussed and compared with theoretical predictions. The optimal control requires only a slightly more complex feedback circuit, but it reduces considerably the energy put into the system. (auth)

26532 INSTABILITIES IN A ROTATING ELECTRON PLASMA. Kjellmert, B. (Uppsala Univ.). Nuovo Cim.; 13B: No. 2, 379-395(11 Feb 1973).

Some new internal instabilities are derived for a plasma where the equilibrium system consists of electrons rotating about an axis of symmetry parallel to a confining external magnetic field. Effects due to the self-consistent magnetic field and the neutralizing immobile ions are considered. A small-signal analysis of the initial perturbations is performed. It indicates that instabilities of at least three different types appear in a pure electron gas. One of them can also develop in the neutralized plasma. The growth rates are estimated. (auth)

26533 FREQUENCY ENTRAINMENT OF A DRIFT INSTABILITY BY NONLINEAR EFFECTS IN A PLASMA. Tavzes, R.; Cercek, M. (Univ., Ljubljana, Yugoslavia). Phys. Lett., A; 43A: No. 2, 99-100(26 Feb 1973).

Experimental results were obtained which show that the drift instability can be described by the Van der Pol equation. The driving signal was coupled to the plasma by the modulation of the microwave power that produced the plasma at ecr. (auth)

26534 EFFECT OF ROTATIONAL TRANSFORM ON THE OHMICALLY HEATED PLASMA IN THE WIIb STELLARATOR. Grieger, G. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.); Jaenicke, R.; Juulman, C. O. L.; Mahn, C.; Renner, H.; Ringler, H.; Schilling, G.; Wolf, G. H.; Hugill, J. Plasma Phys.; 15: No. 2, 151-155(Feb 1973).

Instabilities of the plasma current have been observed when the transform near the plasma boundary is rational, whose strength decreases with increasing mode number. The $t = \frac{1}{2}$ instability is sufficiently strong to limit the current attainable. The instabilities do not seem to depend strongly on other plasma parameters. (UK)

26535 STABILITY OF ROTATING PLASMA IN CROSSED ELECTRIC AND MAGNETIC FIELDS. Dolgopolov, V. V.; Sizonenko, V. L.; Stepanov, K. N. (Physical-Technical Inst., Kharkov). Ukr. Fiz. Zh. (Russ. Ed.); 18: No. 1, 18-28(Jan 1973). (In Russian).

Stability of a plasma cylinder placed in radial electric and longitudinal magnetic fields is considered, the plasma electrons and ions rotating with different angular velocities. Oscillations with increment not exceeding ion gyrofrequency are studied, together with oscillations with increment considerably exceeding ion gyrofrequency. (auth)

Thermonuclear Engineering and Equipment

Refer also to abstracts 24357, 24358, 24519, 24626, 25182, 25392, 25604, and 26044.

26536 (ANL-7807) SURVEY OF THERMONUCLEAR-REACTOR PARAMETERS. Persiani, P. J.; Lipinski, W. C.; Hatch, A. J. (Argonne National Lab., Ill.). Oct 1972. Contract W-31-109-eng-38. 25p. Dep. NTIS $3.00.

This preliminary survey makes available for ready reference some of the important thermonuclear-reactor parameters generated by the variety of concept studies reported in the open literature. Many of the more than 25 studies are essentially partial design concepts, emphasizing specific problem areas involved in developing a fusion power reactor. The term "design" in this report will be applied to all the sets of parameters cited, even though in many cases only a few self-consistent parameters are used to illustrate a limited aspect of the overall design problem. The composite tabulation of these parameters does allow a measure of convenience in scoping the overall design problem. The composite tabulation of these parameters does allow a measure of convenience in scoping the overall effort that has been applied to the general area of feasibility and development of fusion reactors (as distinguished from plasma problems). The parameters are presented in such a way as to compare the reactor types and to identify major subsystems that have as yet received only minimal attention. Although a comparison of certain selected parameters is indeed an objective of this compilation, an evaluation of each of the systems and/or subsystems is beyond the scope of this report. It is also intended that the compilation will serve as background material for a subsequent phase of developing a coordinated overall reactor systems-design study. In this manner, an overall systems study would bring into better perspective the many conflicting design constraints and interface problems. (auth)

26537 (CONF-730302-5) NUCLEAR FUSION CHAIN REACTION APPLICATIONS IN PHYSICS AND ASTROPHYSICS. McNally, J. R. Jr. (Oak Ridge National Lab., Tenn.). 1972. 15p. Dep. NTIS $3.00.

From Symposium on applications of nuclear data in science and technology; Paris, France (12 Mar 1973).

A review of major developments in controlled fusion involving magnetic mirror machines is given. Fokker–Planck calculations of scaling laws for mirror machines are briefly discussed. Some reaction kinetics are described. (MOW)

26538 (CONF-730315-1) STATUS OF THE ORMAK EXPERIMENT. Kelley, G. G.; Berry, L. A.; Clarke, J. F.; Colchin, R. J.; Edmonds, P. H.; McNally, J. R.; Murakami, M.; Neidigh, R. V.; Roberts, M.; Wing, W. R. (Oak Ridge National Lab., Tenn.). 8 Mar 1973. 8p. Dep. NTIS $3.00.

From 3rd International symposium on toroidal plasma confinement; Garching, F.R. Germany (26 Mar 1973).

Results from the ORMAK experiment are described. Particular emphasis is placed on loss processes. It is concluded that (1) the ion plasma is significantly collisionless. The effective collision frequency (neglecting impurities) implies an ion energy diffusion loss rate of about a factor of six less than the value predicted by Artsimovich scaling which assumes plateau regime behavior. (2) The actual ion energy containment times are only slightly longer than predicted from Artsimovich scaling but there is strong evidence that the dominant ion energy loss mechanism is by charge exchange and the diffusion loss may well be neoclassical. (3) Electron energy loss is ultimately by charge transfer to the ion and by radiation. The data on which these conclusions are based are presented and a brief discussion is given of the future plans which include heating by energetic neutral particle injection now being installed and a modification of coil structure which is around operation at 50 kG. (auth)

26539 (EUR-4938) PROCEEDINGS OF THE 7th SYMPOSIUM ON FUSION TECHNOLOGY, GRENOBLE (FRANCE), OCTOBER 24–27, 1972. (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). Dec 1972. 483p. (CONF-721058-). EUR B.Fr. 700.-.

From seventh symposium on fusion technology; Grenoble, France (24 Oct 1972).

Separate abstracts were prepared for 59 of the included papers. One remaining paper appeared previously in NSA 27: 13740. (MOW)

For abstracts of individual papers see: 24357, 24358, 25326, 25692, 26443, 26459–26464, 26479, 26540–26585, and 27172.

26540 (EUR-4938, pp 21-26) HALL ACCELERATOR AS A REACTOR DIVERTOR SIMULATOR. Cole, H. C.; McCracken, G. M.; Travis, A. J.; Erents, S. K.; Hill, J. W. (Culham Lab., Abingdon, Eng.). Dec 1972.

From seventh symposium on fusion technology; Grenoble, France (24 Oct 1972).

The device can irradiate specimens of tens of square centimeters with plasma having an energy distribution peaking at ~10 keV at an energy density of ~100 W/cm^2. This corresponds to an ion flux of a few times 10^{16} ions/cm^2/sec. As a mixture of ions can be produced the fusion exhaust plasma can be closely simulated. As a preliminary test of the suitability of the accelerator for surface studies, some samples of molybdenum have been bombarded and examined for surface blistering. After exposure to the plasma the samples were examined in a scanning electron microscope. The results indicate that despite the relatively high diffusion coefficient of hydrogen in molybdenum, surface damage can be produced by agglomeration of implanted gas in the metal lattice. The small blister size is explained by the low energy used, roughly proportional to incident ion energy. Surfaces exposed to 100 pulses of H ions showed no visible sign of damage. Further samples have been exposed to 15 and 100 pulses of the plasma. After the lower dose there was evidence of very small blisters which were similar though of small diameter than those obtained after He^+ ion beam irradiation at 7 kV. The high-dose samples showed obvious erosion of the target particularly around grain boundaries. (EU)

26541 (EUR-4938, pp 27-39) SPUTTERING IN A FUSION REACTOR AS A FUNCTION OF TOTAL ENERGY AND TEMPERATURE OF THE PARTICLES BOMBARDING THE WALL. Behrisch, R.; Vernickel, H. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). Dec 1972.

From seventh symposium on fusion technology; Grenoble, France (24 Oct 1972).

Sputtering yields for H^+, D^+, T^+, He^+, Nb^+ ions and neutrons as a function of bombardment energy were collected and extrapolated to the range of interest for a CTR. The particle flux from a fusion plasma to the first wall was estimated from the α-energy released in the plasma, which has to come to the first wall. Erosion of the first wall due to sputtering was calculated for different energy distributions and mean energies for the particles coming to the first wall. Assuming a constant amount of energy, transported to the first wall by particles, the erosion by sputtering is maximum for a mean particle energy of 500 eV to 1 keV. For lower and higher mean particle energies the sputtering rates decrease only slowly. The results indicate that sputtering is a serious erosion process unless the charged particles are either guided into a divertor (transferring the problems thither) or the temperature of the outer plasma region can be maintained below 50 eV. (auth)

26542 (EUR-4938, pp 41-49) SURFACE EFFECTS IN THERMONUCLEAR DEVICES AND REACTORS. Kaminsky, M. (Argonne National Lab., IL). Dec 1972.

From seventh symposium on fusion technology; Grenoble, France (24 Oct 1972).

Energetic particles and photons coming both from the plasma and from secondary processes and impinging on the walls of thermonuclear devices and reactors can cause a variety of physical and chemical processes, e.g., physical and chemical sputtering, radiation blistering, radiation damage, secondary-electron and x-ray emission, photodecomposition of surface compounds, and particle entrapment. The plasma contamination and wall erosion caused by some of these processes are reviewed, with emphasis on processes that are common to various types of fusion reactors and fuel cycles. Recent estimates of the lifetimes of walls made of Nb, for example, will be updated on the basis of new values for the rate of erosion by radiation blistering. (auth)

26543 (EUR-4938, pp 99-105) DEVELOPMENT OF FUSION REACTOR TECHNOLOGY. Hancox, R. (Culham Lab., Abingdon, Eng.). Dec 1972.

From seventh symposium on fusion technology; Grenoble, France (24 Oct 1972).

Past progress in fusion reactor studies is reviewed. The present state of fusion reactor technology is discussed, with particular reference to its aims and possible future development. (auth)

26544 (EUR-4938, pp 107-112) NEUTRON-FLUX ASYMMETRY IN TOROIDAL GEOMETRIES. Daenner, W. (Max-Planck Institut fuer Plasmaphysik, Garching, Ger.). Dec 1972.

From seventh symposium on fusion technology; Grenoble, France (24 Oct 1972).

The asymmetry of the primary neutron flux in a fusion reactor of toroidal shape has not yet been investigated. It was feared that this phenomenon could possibly be one more factor limiting the mean wall loading. A method is described for evaluating the real 14-MeV neutron flux, including its angular distribution, as dependent on the position of a point at the small wall perimeter with respect to the geometrical parameters of the toroidal arrangement. Typical results presented for the case of a Tokamak reactor indicate that there is no reason to claim a reduction of the mean wall loading due to this effect. (auth)

26545 (EUR-4938, pp 113-124) MODULAR FUSION-REACTOR BLANKET SYSTEM WITH HEAT PIPES AND HELIUM COOLING. Beghi, G.; Busse, C. A.; Casini, G.; Farfaletti Casali, F.; Fiebelmann, P.; Peter, F.; Putzeys, J.; Volta, G. (EURATOM, Ispra, Italy). Dec 1972.

From seventh symposium on fusion technology; Grenoble, France (24 Oct 1972).

The feasibility of a fusion power reactor blanket composed of a number of independent and replaceable modular annular segments is discussed. The inner part of the segments is a chamber containing quasi-stagnant lithium. The first vacuum wall, made of thin corrugated foils of TZM or vanadium-base alloy, is supported by a cellular structure, capable of withstanding differential thermal dilatations without significant stresses and of assuring the rigidity of the whole assembly. A set of heat pipes penetrating radially into the lithium chamber transfers the heat generated in the lithium to the outer cooling system and is also used for tritium separation and recovery. The heat-pipe condensers are cooled by helium circulating in the graphite absorber zone. (auth)

26546 (EUR-4938, pp 125-130) COMPARISON OF DIRECT AND INDIRECT COOLING OF FUSION-REACTOR BLANKET CONTAINING LITHIUM. Mitchell, J. T. D.; Booth, J. A. (Culham Lab., Abingdon, Eng.). Dec 1972.

From seventh symposium on fusion technology; Grenoble, France (24 Oct 1972).

A fusion reactor structure is described for a DT fusion reactor using Tokamak confinement. Using this model, direct circulation of the lithium in the blanket is compared with indirect helium cooling. The maximum wall loadings are determined. In both cases these are limited by the acceptable working stress in the structural material of the blanket. It appears that helium cooling would be satisfactory at higher wall loadings than the direct lithium cooling. (auth)

26547 (EUR-4938, pp 131-136) LITHIUM AND FLIBE AS COOLANTS FOR FUSION-REACTOR BLANKETS. Daenner, W. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). Dec 1972.

From seventh symposium on fusion technology; Grenoble, France (24 Oct 1972).

Some results of preliminary investigations about lithium and flibe as coolants for fusion reactor blankets are presented. Based upon the assumption of a channel flow, the thermohydraulic characteristics are derived. From these equations, three conditions are evaluated which have to be met by the cooling layout. A subsequent comparison of these conditions leads to the conclusion that the use of flibe involves much less restriction on the design than does the use of lithium. It shows, however, that the realization of a lithium-cooled blanket must not be an impossibility. (auth)

26548 (EUR-4938, pp 137-141) NEUTRON-INDUCED IMPLANTATION OF COOLANT ATOMS INTO BLANKET MATERIALS FOR FUSION REACTORS. Altenhein, F. K.; Andresen, H.; Donner, Ch.; Lutze, W.; Migge, H. (Hahn-Meitner Institut fuer Kernforschung, Berlin). Dec 1972.

From seventh symposium on fusion technology; Grenoble, France (24 Oct 1972).

Effects resulting from the energetic particles impinging on the first wall of a fusion reactor have been discussed earlier. The question whether similar problems exist in blanket structure materials e.g., neutron induced ion implantation resulting from elastic scattering processes with helium and lithium is now discussed. (auth)

26549 (EUR-4938, pp 143-150) COMPARISON OF TECHNOLOGICAL PROBLEMS IN STAINLESS-STEEL FUSION REACTOR BLANKETS AND FAST-BREEDER-REACTOR CORES. Koehler, W. H. (INTERATOM, Bensberg, Ger.). Dec 1972.

From seventh symposium on fusion technology; Grenoble, France (24 Oct 1972).

Reasons are presented why technological feasibility, the second step on the way to thermonuclear power generation, should involve stainless steel as a structural material for the blanket. Experience with stainless steel in liquid-metal-cooled fast-breeder reactors in the areas of embrittlement, swelling and radiation induced creep is discussed. Conceptual design features of a CTR stainless steel blanket are indicated. (auth)

26550 (EUR-4938, pp 169-181) WHY FUSION IN THE EUROPEAN COMMUNITY. Palumbo, D. (EURATOM, Brussels). Dec 1972.

From seventh symposium on fusion technology; Grenoble, France (24 Oct 1972).

Figures on the energy demand and its trends in the European Community are presented, followed by considerations on the economic potentialities of fusion. (auth)

26551 (EUR-4938, pp 183-188) CONSTRUCTION OF A THIN WALLED ALUMINA TORUS SURROUNDED BY COPPER SHIELDS. Zwart, J. W. A. (FOM-Instituut voor Plasmafysica, Jutphaas, Netherlands). Dec 1972.

From seventh symposium on fusion technology; Grenoble, France (24 Oct 1972).

The described torus serves for a toroidal pinch experiment with a capacitor bank of 160 kJ at 40 kV. For physical reasons the copper shield of about 5-mm thickness must be as close as possible to the plasma and the torus must have a very small aspect ratio. The inside dimensions of the torus are: major radius 18 cm and minor radius 8 cm. The insulation between copper shield and plasma is 2 mm thick and the gaps between the copper shields are 1 mm wide. The breakdown voltage of the insulation is about 20 kV. The insulation consists of 1 mm plasma-sprayed ceramic facing the plasma and 1 mm cast epoxy which connects the ceramic to the copper shields. The electrical and vacuum properties of the insulation as well as the method of manufacturing such a torus will be described. (auth)

26552 (EUR-4938, pp 189-194) SCYLLAC, EIGHTEEN MONTHS LATER. Hammer, C. F.; Harris, H. W.; Quinn, W. E.; Sawyer, G. A.; Thomas, K. S.; Kemp, E. L. (Los Alamos Scientific Lab., NM). Dec 1972.

From seventh symposium on fusion technology; Grenoble, France (24 Oct 1972).

Scyllac is a 15-meter-long toroidal theta-pinch machine and uses a capacitor bank as its primary energy source. The capacitor bank will contain 3150 1.85-μF capacitors rated at 60 kV, and a total stored energy of 10.5 MJ. Phase One of the Scyllac program consists of doing two intermediate theta-pinch experiments, one being a 5-meter curved sector, the other is a 5-meter linear machine with mirrors. The 5-meter curved sector has been an operational experiment since March 1971. The experiments performed on this machine deal with stabilization techniques required for a toroidal theta pinch. To date plasma containment time has been as long as 11 μsec. The linear experiment became operational March 1972. The experiments performed on this machine have dealt with the problems of a long, high-beta theta

pinch with mirrors. The mirror field to pinch field ratio is 2.5:1. Containment time for this machine is approximately 15 μsec. From an engineering standpoint the Scyllac project has been a very challenging effort since most of the components have been recently developed, complicated by the large numbers used. An important part of the Scyllac effort was the testing of critical components such as capacitors, cables, and spark gaps, prior to installation. This pretesting has significantly improved the reliability of the Scyllac system over previous theta-pinch systems. This paper will present the design, installation, and special features of the Scyllac system. (auth)

26553 (EUR-4938, pp 195-205) TECHNICAL ASPECTS OF FUTURE TOROIDAL HIGH-β EXPERIMENTS. Breit, E.; Gruber, J. E.; Knobloch, A. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). Dec 1972.

From seventh symposium on fusion technology; Grenoble, France (24 Oct 1972).

Future large bank systems achieve a great simplicity by use of standard 2-kJ metal case capacitors, parallel transmission lines and simple spark gaps for start and crowbar duty. Economic reasons lead to a 20-kJ basic element size. A 20-MJ system study for a high-β-Stellarator is discussed. Description is also given for the new belt-pinch experiment, whose bank system was designed for high flexibility in changing experimental parameters. This bank is built in a modular way, having capacitors and the switching system independently arranged in racks. (auth)

26554 (EUR-4938, pp 207-212) FRASCATI TOKAMAK: DESIGN INFORMATION. (Laboratori Gas Ionizzati, Frascati, Italy). Dec 1972.

From 7th symposium on fusion technology; Grenoble, France (24 Oct 1972).

Description and specifications of the toroidal magnet are described. (EU)

26555 (EUR-4938, pp 213-220) DESIGN AND INSTALLATION OF THE GARCHING TOKAMAK FACILITY PULSATOR I. Allgeyer, R.; Baeumler, G.; Gernhardt, J.; Herppich, G.; Jakobus, W.; Kerl, F.; Klueber, O.; Knobloch, A.; Lohnert, H.; Ludescher, Ch.; Poehlchen, R.; Roos, H. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). Dec 1972.

From 7th symposium on fusion technology; Grenoble, France (24 Oct 1972).

Pulsator I is a Tokamak machine with a major torus radius of 70 cm and plasma radius of 12 cm. The main magnetic field coils are producing an axial-toroidal magnetic field of 28 kG. They are energized by a 14 MJ flying wheel machine. Pulsator I includes an iron transformer core for 0.42 Vs at 15 kG in the central part and 0.77 Vs in the eight return yokes. The induction windings of the iron transformer are driven by an 18 kV primary capacitor bank (80 kJ) followed by a 310 V electrolytic capacitor power crowbar bank (200 kJ). They are producing a plasma current of 300 kA by a pulse length of about 100 ms. The maximum loop voltage is 1.2 kV. The stainless steel torus with four insulating slots serves as the vacuum vessel and as a main support structure for the pulsed auxiliary windings. This water cooled chamber carries on its outer surface a $l = 2$; $n = \frac{1}{2}$ helical winding and a vertical field winding as well as the parts of the 2.5 cm thick copper shell. Electrolytic capacitor banks controlled by power transistors will generate flexible current programs for the helical and internal vertical field windings. The external vertical field windings are fed by a small slow rotating pulse generator. The most essential parts and materials have already been made and installed. The machine will be in operation at the end of this year. (auth)

26556 (EUR-4938, pp 221-226) LARGE 100-MW PULSED MAGNETIC COIL FOR FUSION RESEARCH. Huguet, M. (CEN, Fontenay-aux-Roses, France); Rebut, P. H.; Torossian, A.; Meier, M. Dec 1972.

From 7th symposium on fusion technology; Grenoble, France (24 Oct 1972).

The main toroidal magnet for the TFR fusion device which is now being assembled at Fontenay-aux-Roses is described. The magnet consists of a 98-cm major radius and 30-cm minor radius torus. It is composed of 24 oil-cooled Bitter-type coils. Each coil consists of 35 turns of full-hard copper insulated with kapton. The total weight of the 24 coils is about 20 tons. A center line field of 60 kG is generated with a current of 35,000 A. The field corrugations along the center line do not exceed 0.5%. With a peak power input of 120 MW and for a mean pulse length of 1.5 s, the energy delivered to the magnet during one pulse is 150 MJ, and the magnetic energy stored is 40 MJ. The repetition rate is one pulse every 4 minutes. (auth)

26557 (EUR-4938, pp 227-232) PRODUCTION OF PULSED HIGH MAGNETIC FIELDS WITH ROTATING MACHINE. Rebut, P. H. (CEN, Fontenay-aux-Roses); Torossian, A.; Delassus, J.; Delaunay, M. Dec 1972.

From 7th symposium on fusion technology; Grenoble, France (24 Oct 1972).

The power source delivering a mean power of 100 MW over a pulse duration of 1.5 sec energizing the main toroidal magnet of the TFR experiment is described. The power source includes an asynchronous motor of 1.2 MW running up to 1500 rpm and driving through a gear box a flywheel storing 400 MJ at 6000 rpm. The energy is delivered to the load through a 150-MVA diode rectifier. (auth)

26558 (EUR-4938, pp 233-238) DESIGN OF CLEO STELLARATOR/TOKAMAK. Plummer, K. M.; Sanders, B. C.; Millward, P.; Hunt, R. R.; Skelton, D. E.; Bayes, D. V.; Hay, J. (Culham Lab., Abingdon, Eng.). Dec 1972.

From 7th symposium on fusion technology; Grenoble, France (24 Oct 1972).

Cleo is a stellarator with a 7-field period, 120-kAT helical winding of 178 mm mean radius. The toroidal field strength of 20 kG (on the plasma axis) is produced by 24 liquid-nitrogen-cooled coils. An iron transformer core of 0.82 volt seconds is fitted for ohmic heating and discharge cleaning. The electrical control circuits use solid-state logic and output devices. The machine is at present being operated as a tokamak, using another torus, and will be converted to a stellarator early in 1973. (auth)

26559 (EUR-4938, pp 239-249) STATUS AND TECHNICAL CONCEPT OF THE GARCHING STELLARATOR WENDELSTEIN VII. Blaumoser, M.; Freudenberger, K.; Grieger, G.; Jaenicke, R.; Junker, J.; Knobloch, A.; Kolos, J.; Kunze, R. C.; Lohnert, H.; Oswald, B.; Poehlchen, R.; Streibl, B.; Wobig, H.; Wolf, G. H. (Max-Planck Institut fuer Plasmaphysik, Garching, Ger.). Dec 1972.

From 7th symposium on fusion technology; Grenoble, France (24 Oct 1972).

A short survey of the main parameters of the stellarator Wendelstein VII is given including some of the design criteria. Particular features of the vacuum tube, the helical windings and the main field coils are briefly discussed. (auth)

26560 (EUR-4938, pp 251-256) CULHAM SUPERCONDUCTING LEVITRON ENGINEERING DESIGN. Skellett, S. (Culham Lab., Abingdon, Eng.). Dec 1972.

From 7th symposium on fusion technology; Grenoble, France (24 Oct 1972).

In the levitron machine a superconducting hardcore coil or "ring" has a persistent current induced in it, and is floated magnetically within the containment field eliminating the need for physical supports intruding into the plasma. The Superconducting levitron uses a coil of 60-cm diameter wound from 4500 turns of Nb, Ti superconducting wire, and welded into a stainless steel case. Further superconducting field coils provide an axial field and water cooled conductors provide a toroidal field. In practice this comparatively simple concept is complicated by the need to build the experiment to a high accuracy, and to provide refrigerated clamps to cool the ring down; positioning clamps; a position sensing and stabilising system, to maintain the ring accurately in the center of the magnetic system; thermal radiation shields and thermocouples; a "catcher" system to prevent damage if the ring becomes unstable; cold helium gas and liquid nitrogen supplies; and plasma injection and diagnostic devices. All these systems compete for space, and must be designed to very high standards of reliability, and where possible be replaceable with minimum disturbance to the rest of the experiment. (auth)

26561 (EUR-4938, pp 263-266) 8-MW AMPLIFIER WITH 1 MICROSECOND RISETIME FOR PLASMA STABILIZATION. Harding, G. E. S. (Culham Lab., Abingdon, Eng.); Anderson, J. H. Dec 1972.

From 7th symposium on fusion technology; Grenoble, France (24 Oct 1972).

The paper describes an amplifier which supplies current up to 300 A into an inductive load of 18 μH, with rise and fall times of about 1 μs and a duration of about 30 μs. The input signal for full drive is 10 volts. A magnetically-beamed triode with high power gain, Machlett ML-8618, is used as output valve, which needs 50 kW pulse drive power. To provide this power without an impracticably large continuous current, the last two stages of the drive amplifier are quiescent during standby, the grid of the output valve being held strongly negative. Prior to the active period, these stages are pulsed into operation. The signal applied to the grid of the output valve consists of the amplified input signal superimposed on a "pedestal" voltage which brings the valve to its correct operating condition. This technique enables the band-

width and phase-shift to be closely controlled, permitting the use of relatively small components in the final stages of the drive amplifier. (auth)

26562 (EUR-4938, pp 267-272) CRYOGENIC EXPERIMENTAL DEVICE FOR PRODUCTION OF SOLID PELLETS. Tanimoto, M. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). Dec 1972.

From 7th symposium on fusion technology; Grenoble, France (24 Oct 1972).

A cryogenic apparatus is described that is able to supply solidified pellets into various plasma-confinement machines. A free jet of liquid argon or oxygen flows out of a nozzle into a low pressure gas. Due to capillary instability the liquid cylinder breaks into droplets. This is forced by a piezoelectric transducer which oscillates in the 100 Hz ~ 100 kHz range. The droplets are solidified during flight. Then they can be guided and accelerated by particle optics into the vacuum chamber. The number of atoms contained in a pellet and the injection rate are variable according to the conditions required by plasma machines. They range from 10^{11} to 10^{20} atoms per pellet with sizes 1 ~ 1000 μ and up to a repetition rate of a few kHz. These experiments will also be carried out with hydrogen and deuterium. Such pellets which are heated by radiation of high power and high repetition rate laser could be used for generation of plasmas in toroidal magnetic fields. (auth)

26563 (EUR-4938, pp 273-278) FAST-NEUTRAL INJECTORS FOR THE CULHAM SUPERCONDUCTING LEVITRON. Burrows, B.; Collins, P.; Coupland, J.; Hammond, D. P.; Riviere, A. C. (Culham Lab., Abingdon, Eng.). Dec 1972.

From 7th symposium on fusion technology; Grenoble, France (24 Oct 1972).

The injection into the Culham levitron will be initially 50 mA of 5-keV H° particles, with an associated background gas pressure in the plasma region not exceeding 10^{-9} torr. Subsequently, it is planned to relax the background gas requirement and to increase the injected beam by an order of magnitude. The first injector has been installed and details of its performance are given. The ion source used is a modified duo-plasmatron with single aperture accel/decel extraction geometry, and the beam is transmitted via a magnetic solenoid lens. In the design of the higher current system the lens is omitted and the results of experimental work on single aperture geometries have been used to design a multi-aperture system. The salient parameters affecting the design of the high current injection are discussed. (auth)

26564 (EUR-4938, pp 285-295) SUPERCONDUCTING COIL SYSTEM FOR A LARGE TOKAMAK EXPERIMENT. Martinelli, A. P. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). Dec 1972.

From 7th symposium on fusion technology; Grenoble, France (24 Oct 1972).

Some major problems expected in designing a superconducting coil system for a large Tokamak are described, e.g., the effect of the pulsed magnetic field produced by the transformer coil and plasma current on the superconducting windings; the use of a single cryostat for each coil rather than a common cryostat for the whole coil system. Several factors suggest operating large superconducting coil systems in helium gas or supercritical helium at temperature higher than 4.2°K, viz., economy of the coil refrigeration system, safety, and less degradation and better stability of high temperature transition materials subject to flux jumping. Very effective heat transfer with gaseous helium can be obtained, and generally gaseous helium should be preferred to liquid helium. The experience gained in operating large Nb_3Sn coils in helium gas for the We levitated quadrupole is extended to large systems. (auth)

26565 (EUR-4938, pp 297-302) STRUCTURAL DESIGN PROBLEMS OF LARGE SUPERCONDUCTING MAGNETS FOR TOROIDAL REACTOR SYSTEMS. Crawley, H. J. (Culham Lab., Abingdon, Eng.). Dec 1972.

From 7th symposium on fusion technology; Grenoble, France (24 Oct 1972).

A brief account is given of the methods used to calculate the bursting stresses and net force on a toroidal array of magnets. Results are given for a set of reactor dimensions which suggest a field maximum of about 10 teslas. The practical implication of large net forces on the magnets is discussed. (auth)

26566 (EUR-4938, pp 303-309) TRANSMISSION FORCES TO A CRYOSTAT. Gianese, P.; Porrot, E.; Rey, G.; Taquet, B. (CEN, Grenoble, France). Dec 1972.

From 7th symposium on fusion technology; Grenoble, France (24 Oct 1972).

This paper gives the measurements of elastic modulus and mean thermal conductions between 4.77 and 300°K under compressive stress almost up the ultimate strength, for a set of pure and glass reinforced plastics. The ratio compressive modulus mean thermal conduction allows this kind of material to be classified and used as supports to transmit compressive stress through a cryostat. The thermal and mechanical properties of fiberglass plastic vary with the direction of the applied force, with respect to the fiber direction. This behavior allows this plastic to resist large forces with small thermal losses and displacements. (auth)

26567 (EUR-4938, pp 311-318) INFLUENCE OF RADIATION DAMAGE TO SUPERCONDUCTING NbTi COILS FOR FUSION REACTORS. Soell, M. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). Dec 1972.

From 7th symposium on fusion technology; Grenoble, France (24 Oct 1972).

The influence of radiation damage to the critical current of superconducting NbTi and to the stabilization materials is treated. As regards the stabilization, a NbTi multifilament wire (Nb–50 wt % Ti, copper-to-superconductor ratio 3:1), was exposed to neutron irradiation at 5°K. During the irradiation the copper sheath lost the stabilizing effect by an increase in the resistivity. After annealing at 270°K the stabilization was fully recovered. The other problem, the behavior of the critical current of NbTi after proton, deuteron, and neutron irradiation, is considered, with emphasis on the influence of neutron irradiation. All experiments show a reduction of critical currents from the original values. Subsequent annealing at different temperatures brought an improvement in the critical current each time. These results are applied with respect to possible neutron doses during the lifetime of a fusion reactor magnet. (auth)

26568 (EUR-4938, pp 319-322) PROPERTIES OF THE AIR-CORE TRANSFORMER IN TOKAMAKS. Schram, D. C. (FOM Instituut voor Plasmafysica, Jutphaas, Netherlands); Rem, J.; Taylor, R. J.; Montgomery, D. B.; Hugenholtz, C. A. J.; Minardi, E.; Ornstein, L. Th. M. Dec 1972.

From 7th symposium on fusion technology; Grenoble, France (24 Oct 1972).

In aircore transformers used in tokamaks, the eddy currents in copper parts of the primary of the transformer and of the main magnetic field coils can cause a change in the time behavior of the induced plasma current. It is shown that the effect enhances the coupling on a fast time scale due to which the initial current rise is increased. However, on these time scales the vertical stray fields are not fully compensated. It is suggested to obtain a dynamic compensation by delaying the collapse of flux in the compensation windings. (auth)

26569 (EUR-4938, pp 323-332) CALCULATION OF NET FORCES AND MECHANICAL STRESS IN THE TOROIDAL FIELD COIL SYSTEM OF THE WENDELSTEIN VII, PULSATOR, AND WEGA. Poehlchen, R.; Ludescher, Ch. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). Dec 1972.

From 7th symposium on fusion technology; Grenoble, France (24 Oct 1972).

The main confining magnetic field of a stellarator and also of a tokamak is generated by a number of coils with access space between the coils. The coils are equally spaced along the [illegible]or circumference of the torus, and the axis of rotation of each [illegible] is tangential of the minor axis of the torus. First, the three-dimensional magnetic field in the winding of one coil of the toroidal coil configuration is computed. The vector product of the current density and the magnetic induction leads to the body force pattern in the coil winding. These body forces are used to calculate the net forces between the coils, especially if one coil and also if one half of the coil system fails. The net forces must be known in order to design the supporting structure and the optimum electric connection between the coils. In addition, a stress analysis for the circular cylindrical coils is made. The mechanical stresses which arise in current carrying coils, especially in high field magnets with large diameter, can result in its destruction. Hence, in particular, it is necessary to calculate the maximum stress in the winding and the location of the maximum stress. (auth)

26570 (EUR-4938, pp 333-344) MAGNETIC FORCES ON HELICAL WINDINGS OF A STELLARATOR AND RESULTING DEFORMATION OF THE SUPPORTING STRUCTURE. Streibl, B. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). Dec 1972.

From 7th symposium on fusion technology; Grenoble, France (24 Oct 1972).

The magnetic forces originating in the helical windings of a stellarator are described and the principles underlying the construction of their supporting structure are explained. The mechanical dimensioning of the structure requires a knowledge of the

deformations. Using as a model a cylindrical stellarator, these are calculated as a function of the helix pitch angle, and the space is estimated which winding and supporting structure would occupy of the l = 3 stellarator in comparison with the l = 2 stellarator of reactor size. The comparison is extended to the magnetic field parameters which were calculated numerically for the toroidal case. (auth)

26571 (EUR-4938, pp 345-357) STELLARATOR COIL SYSTEM WITHOUT HELICAL WINDINGS. Wobig, H.; Rehker, S. (Max-Planck-Institut fuer Plasmaphysik, Garching, Ger.). Dec 1972.

From 7th symposium on fusion technology; Grenoble, France (24 Oct 1972).

Stellarator fields produced by elliptical coils are investigated numerically. It is found that twisting of the elliptical coils increases the rotational transform appreciably. For reactor dimensions (l = 2 stellarator) iota ≃ 0.2 to 0.3 can be reached. Also the forces on the coils and the effect of divertor coils are investigated. (auth)

26572 (EUR-4938, pp 359-364) RING POSITION CONTROL FOR LEVITRON. Last, J. R. (Culham Lab., Abingdon, Eng.). Dec 1972.

From 7th symposium on fusion technology; Grenoble, France (24 Oct 1972).

A current carrying superconducting ring is levitated and held in stable vertical equilibrium by fixed fields due to vertical field coils. However it is in unstable equilibrium for horizontal and angular motions, which are also coupled by a toroidal field. The position control servo stabilises these motions and holds the ring at its central equilibrium position. The position of the ring is detected by its intersection with light beams and signals are fed, via amplifiers, to stabiliser coils, whose magnetic field opposes movement of the ring from the central position. If the control system fails, the ring will rapidly accelerate away from the center of the machine. To limit the consequences of this, it is surrounded by an aluminium alloy cage. Movement of the ring induces currents in the cage, which slow its motion. The cage also acts as a mechanical buffer to finally stop the ring. (auth)

26573 (EUR-4938, pp 365-371) RESPONSE-TIME CONSIDERATIONS OF MAGNET POWER SUPPLY. Miyahara, A.; Kubota, Y.; Matsuura, K.; Saad, H. M. M. (Nagoya Univ., Japan). Dec 1972.

From 7th symposium on fusion technology; Grenoble, France (24 Oct 1972).

Design and construction of SCR controlled magnet power supply with feedback loop is described. Shunt resistance followed with operational amplifier is adopted as sensing element, and by means of this method, a good time response was obtained. Short-pulse-width operation down to 0.1 second has been achieved for 2500 kW (steady)/12000 kW (pulse) magnet power supply. (auth)

26574 (EUR-4938, pp 373-380) SWITCH SYSTEM FOR HIGH-β EXPERIMENTS. Klement, G.; Wedler, H. (Max-Planck Institut fuer Plasmaphysik, Garching, Ger.). Dec 1972.

From 7th symposium on fusion technology; Grenoble, France (24 Oct 1972).

A switch system consisting of a simple three-electrode atmospheric spark gap suitable both as a start and as a crowbar switch was developed. In particular, its use as a crowbar switch was investigated. The probability of simultaneous breakdown of the two gaps was measured as a function of the asymmetry of the gaps. Furthermore, the time delay between the trigger pulse and the takeover of the main current in the crowbar switch was investigated for three different trigger versions. Trigger mode C, which the measurements show to be the most reliable of the three, was tested in 10-, 20- and 40-kJ units. (auth)

26575 (EUR-4938, pp 381-387) COMBINED ARC AND METAL-TO-METAL SWITCH WITH LOW RESISTANCE AND ACCURATE SWITCHING TIME. Dokopoulos, P.; Lochter, M.; Waelbroeck, F. (Institut fuer Plasmaphysik, Juelich, Ger.). Dec 1972.

From 7th symposium on fusion technology; Grenoble, France (24 Oct 1972).

A combined solid dielectric crowbar switch presenting simultaneously the fast and accurate response of a field distortion spark gap (~20 ns) and, for long time behavior, the low resistance ($\mu\Omega$) of a metal-to-metal contact is described. At current maximum, a field distortion switch incorporated in the system can be closed by many arcs within a time of ±20 ns. Within a time of ≤2 μs the crowbarred current is overtaken by a metal-to-metal contact with a resistance of ~10 $\mu\Omega$. The resistance of the field distortion switch is of the order of a few mΩ, but, since the current flows only for a short time through it, no significant current decrement results. The system has been successfully tested at 60-kV discharge voltage and currents up to 450 kA. It is intended to use the switch to improve the present crowbar system on the 100-kJ toroidal plasma experiment TEE. (auth)

26576 (EUR-4938, pp 389-394) STATISTICAL-PERFORMANCE DATA FOR A HIGH-CURRENT 60-kV SPARK-GAP SWITCH. Burden, R. A.; James, T. E. (Culham Lab., Abingdon, Eng.). Dec 1972.

From 7th symposium on fusion technology; Grenoble, France (24 Oct 1972).

This experimental investigation was made to measure the premature breakdown and electrode erosion rate of a 60 kV 40 nH pressurized air field distortion spark gap. This data is required to assess how far capacitor bank technology can be extended for future applications requiring stored energies of up to 100 MJ. The preliminary experiments that have already been reported have been extended up to peak currents of 400 kA and repetition rates of 8 pulses/minute at 8 C/shot with a premature rate approaching 10^{-4}. Over 10^6 coulombs have been passed by one set of electrodes without significant deterioration in breakdown time or voltage hold-off. Further tests have been carried out at 1.0 MA 50C/shot for a limited number of shots without premature breakdowns. (auth)

26577 (EUR-4938, pp 395-402) FAST, CAPACITIVE ENERGY STORAGE SYSTEM WITH PASSIVE CROWBAR AND NONLINEAR DAMPING RESISTORS. Jerzykiewicz, A. (Inst. of Nuclear Research, Swierk, Poland). Dec 1972.

From 7th symposium on fusion technology; Grenoble, France (24 Oct 1972).

The passive crowbar in capacitive energy storage systems is applied to decrease voltage reversal and to get unipolar current pulse of high steepness in the inductive loads. After clamping, a weakly damped oscillating discharge is observed, in capacitor branch. This fact causes some difficulties if one would get very low values of voltage reversal and ripple in the load current. The results of theoretical analysis and testing of a system, in which oscillations in capacitor branch were damped after clamping by means of nonlinear resistors, are presented. The 150-kJ system with passive crowbar and nonlinear damping resistors is also described. (auth)

26578 (EUR-4938, pp 403-410) GENERATION OF A SQUARE PULSE CURRENT FOR SUSTAINED THETA-PINCH EXPERIMENTS. Ikeda, N. (Electrotechnical Lab., Tokyo). Dec 1972.

From 7th symposium on fusion technology; Grenoble, France (24 Oct 1972).

As the pulse for the production of plasma in sustained theta-pinch experiments, it will be better to employ a square pulse field than a sinusoidal pulse field. It is therefore important to re-shape the end slope of the pulse waveform by chopping the pulse current. A new type of gap switch module with 8 electrodes was tested for the starting and chopping the pulse current. As the result of a test circuit (V_c = 30 kV, z = 0.9 Ω) with the gap switch above, the waveform of a square pulse current (~20 kA, ~20 μsec) with no ripple is shown and a superposed pulsed field by two square pulse currents with different pulse widths with each other are shown too. (auth)

26579 (EUR-4938, pp 411-416) IMPROVEMENTS IN THE DESIGN OF LINE PULSE GENERATORS. Lietti, A. (Centre de Recherches en Physique des Plasmas, Lausanne, Switzerland). Dec 1972.

From 7th symposium on fusion technology; Grenoble, France (24 Oct 1972).

Line pulse generators giving sinusoidal waveforms are considered. The installation of the "Rotating Field Pinch Experiment" giving 180 kA at 2.7 MHz is described. A 1-MHz line generator is discussed. Economic and technical problems, such as material to be used, cost, and efficiency, are investigated. Special attention is paid to the problem of energy transfer. (auth)

26580 (EUR-4938, pp 417-422) 120-kJ FLEXIBLE ZETA-THETA DEVICE FOR EXPERIMENTS ON AXISYMMETRIC TOROIDAL HIGH-BETA PLASMA. Mondino, P. L.; Rostagni, G. (Univ., Padua). Dec 1972.

From 7th symposium on fusion technology; Grenoble, France (24 Oct 1972).

A very flexible 120-kJ fast capacitor bank system involving four independent circuits (to produce a bias field B_{z0}, a preionizing current I_{θ} and the main B_z and B_θ fields in a toroidal vessel) is described. The four inductors can be connected to the bank sectors directly or via coupling transformers; the firing time of each bank can be varied over a wide range. The primary to secondary ratio of the transformers, when present, can also be varied in order to modify the oscillating frequency of the circuits and so the field

rise time. The main design data and status of the work are reported. (auth)

26581 (EUR-4938, pp 431-440) PULSE TRANSFORMER WITH VARIABLE VOLTAGE FROM 17 TO 95 kV FOR A 1-MJ CAPACITOR BANK. Dokopoulos, P. (Institut fuer Plasmaphysik, Juelich, Ger.); Kohlhaas, W.; Lemmens, R.; Stickelmann, C.; Waelbroeck, F.; Braunsberger, U.; Schwarz, U. Dec 1972.

From 7th symposium on fusion technology; Grenoble, France (24 Oct 1972).

A toroidal plasma experiment will have to be fed by 1.7-MA current at variable voltage from 17 to 95 kV using an existing 1-MJ, 18-kV capacitor bank and a low inductance (0.2 nH) pulse transformer. Among several transformer constructions investigated best results have been obtained using a new concept. The principle for obtaining a transformation ratio of e.g., 3 is: three loops placed side by side are fed by the same voltage source U. The total flux induces the voltage 3.U in a fourth loop, which encircles the other three. The transformer has the advantages: it can be built using plane collectors, i.e., simple construction elements. The variation of the transformation ratio can be achieved by simply changing the way the cables are plugged in; this changes the effective number of loops. (auth)

26582 (EUR-4938, pp 441-446) INDUCTIVE ENERGY STORAGE SYSTEMS APPLIED FOR THE EXTENSION OF CURRENT PULSE DURATION OF CAPACITOR BANKS. Salge, J.; Braunsberger, U. (Technische Univ., Brunswick). Dec 1972.

From 7th symposium on fusion technology; Grenoble, France (24 Oct 1972).

To extend the confinement of high-temperature plasma power crowbar circuits are used. The application of inductive stored energy for this purpose is discussed. The rapidly increasing magnetic field in the load is produced by the discharge of a low inductive capacitor bank. When the load-current has reached its first peak, the capacitor bank is crowbarred and the load is then supplied from an inductive store. The function of the system, the requirements for the circuit elements and the possibilities for a technical realization of the system are investigated. In addition the results of experiments are discussed, conducted on a model circuit. In this case, the inductive store is built up as a transformer; its main inductance is charged by a dc power source. (auth)

26583 (EUR-4938, pp 447-452) PROTECTION OF CAPACITOR BANKS AGAINST DAMAGES DUE TO BREAK DOWNS. Dokopoulos, P.; Liedtke, A. (Institut fuer Plasmaphysik, Juelich, Ger.). Dec 1972.

From 7th symposium on fusion technology; Grenoble, France (24 Oct 1972).

A method was developed to reduce the current resulting from an insulation break down on a collector of a capacitor bank. Capacitive voltage dividers mounted at the collector detect the break down and trigger crowbar switches attached in parallel to the capacitors. The shorter the response time of the protection system with respect to the period of the bank, the lower is the break down current and the damage is reduced. Through the application of this system on a 100-kJ, 35-kHz bank, the destructive energy has been 100 times smaller than without this protection. Such a system was designed for the 1-MJ toroidal experiment TENQ. (auth)

26584 (EUR-4938, pp 453-460) EXPERIMENTAL STUDY OF HIGH-CURRENT FAST SWITCH. Damidau, F.; Delmas, A.; Hochard, L.; Rioux, C. (Univ., Paris, Orsay, France). Dec 1972.

From 7th symposium on fusion technology; Grenoble, France (24 Oct 1972).

A switch was studied with the following characteristics: current interrupted 10^4 A and intensity breakdown time 1 μs. After the interruption of the current, the switch is able to tolerate a high voltage (about 40 Kv) without discharge. The global interruptor is, in fact, made of two parts: (a) A primary switch: a fluid insulating (grease) is accelerated by a strong shock wave, produced by the explosion of a stoichiometric mixture $2\,H_2 + O_2$; the initial pressure of the exploding mixture is about 40 bars. The grease collides with a thin (1/10 de mm) metallic conductor. After this conductor is broken, the grease flows into the free space. An arc arises, which allows current transfer in b; the duration of interruption τ_1 is about 10 μs. (b) An exploding wire connected to the arms of the primary interruptor: during the time τ_1, the wire is practically cold. After its temperature is fastly rising, and after a time τ_2 from the beginning of the transfer the wire explodes; during the time $(\tau_2 - \tau_1)$ the grease is disionizing and the disrupt voltage becomes large. Too, when the wires explode, the primary switch is able to tolerate the voltage gap without discharge. Such a switch exhibits a very good temporal reproductibility with some experimental caution. (auth)

26585 (EUR-4938, pp 461-466) FEASIBILITY OF LARGE CAPACITOR BANKS STORING ABOUT 100 MJ. Hunt, T. W. (BICC Ltd., Helsby, Eng.); James, T. E. Dec 1972.

From 7th symposium on fusion technology; Grenoble, France (24 Oct 1972).

In thermonuclear research, capacitor banks are generally used for applications having energy transfer times less than 10 ms. Existing large systems are in the energy range to 10 MJ, though it is possible that future systems will be required having a stored energy of, say, 50 to 100 MJ. The feasibility of such large capacitor banks is considered, based on the use of high performance capacitors (~20 kJ/unit) and pressurised air spark gaps (~1.0 MA, 50 C/pulse). A possible 100-MJ facility would occupy about 12 × 12 × 25 m allowing adequate space between modules for maintenance and output connections. (auth)

26586 (IAE-2205) ACCELERATING RATE OF DISCHARGE IN A TOKAMAK-6 ASSEMBLY. Vlasenkov, V. S.; Leonov, V. M.; Merezhkin, V. G.; Mukhovatov, V. S. (Institut Atomnoi Energii, Moscow (USSR)). 1972. 17p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.00.

The results of experimental investigations of discharge in the Tokamak-6 facility are reported. A special instability was present, at the moment of development of which the transverse energy of the plasma increased intermittently. In these regimes of discharge the current was transferred by a relatively large group of accelerated electrons with energies of 10 to 500 keV, whereas the fundamental plasma with electron density $\sim 3 \times 10^{13}/cm^3$ had a low temperature (T_e, T_i ~10 eV) and practically did not participate in the transfer of current. The establishment of preliminary ionization of the working gas or the introduction of a comparatively small local nonhomogeneity in the longitudinal magnetic field transferred accelerated charges into a class of common regimes of discharge for Tokamak. (tr-auth)

26587 (IPPJ-T-8) SOME ENGINEERING ASPECT OF JIPP STELLARATOR. Miyamoto, K.; Mohri, A.; Fujiwaka, S.; Inoue, N.; Fujiwara, M. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Apr 1972. 22p.

JIPP-I stellarator is designed for the study of plasma confinement which depends on the parameters of the magnetic configuration such as the rotational transform angle, shear, magnetic well depth as well as the plasma parameters. Therefore the accuracies of magnetic field are carefully considered in the construction. Design studies of this device have been carried out. This paper describes some engineering aspects of the JIPP-I stellarator. (auth)

26588 (JAERI-M-4923) PLANS FOR THE EXPERIMENTS IN THE JFT-2 TOKAMAK WITH EMPHASIS ON CONFIRMATION OF THE AVAILABLE DATA. (Japan Atomic Energy Research Inst., Tokyo). Aug 1972. 31p. (In Japanese). NTIS (U.S. Sales Only).

The program for the preliminary experiments in JFT-2 is described. The experimental data obtained from U.S.S.R. and U.S.A. tokamaks are referred to, and cautions to be taken and problems encountered in application of the data to JFT-2 are given. The course of preliminary experiments in JFT-2 is illustrated, in which preparation of the diagnostic instruments is taken into consideration. The graphs showing the overseas data of tokamaks are so plotted that the results in JFT-2 will be added later for comparison purposes. (auth)

26589 (LA-UR-73-224) LASERS FOR FUSION. Gill, D. H. (Los Alamos Scientific Lab., N. MEX). 1973. 20p. (CONF-730405-1). Dep. NTIS.

From Southwestern Institute of Electrical and Electronics Engineers Conference and Exhibition; Houston, Texas, USA (4 Apr 1973).

A brief review of the theory of absorption of laser light by plasmas and of the necessary requirements for the production of controlled thermonuclear fusion is given. The implications of this theory in regard to the requirements on the laser to be used for fusion are discussed. The three types of lasers being considered for use (electrically pumped gas lasers, chemical, and solid-state lasers) are each described with discussion of their relative advantages and disadvantages. The Nd:glass system is described in greater detail since that system is now being used to study the basic light–matter interactions at a number of laboratories around the world. Finally, mention is made of the present status of, and future plans for, large laser systems now being built at some of those laboratories. (auth)

26590 (ORO-4087-9) TEXAS TURBULENT TORUS EXPERIMENT. Progress Report. (Texas Univ., Austin. Center for Plasma Physics and Thermonuclear Research). Feb 1973. Contract AT(40-1)-4087. 96p. Dep. NTIS $7.00.

The concept of the Texas Turbulent Torus is to combine strong pulsed turbulent heating with the tokamak magnetic confinement geometry. Construction of the experimental facility is complete and initial testing is now in progress. The following diagnostic techniques are described: laser diagnostics, particle and energy loss, microwave interferometry, and electric and magnetic probes, spectroscopy, and electronics and automation. (MOW)

26591 (UCID-16166) DESIGN AND CONSTRUCTION OF FAST HIGH-ENERGY, HIGH-VOLTAGE CAPACITOR BANKS. Hess, W. (California Univ., Livermore. Lawrence Livermore Lab.). 17 Jun 1969. Contract W-7405-eng-48. 72p. Dep. NTIS $5.75.

A typical capacitor bank consisting of the following parts is described in terms of its design and operation: power supply, charge and crowbar system, capacitors, switching system, load, transmission line system, and instrumentation system. (MOW)

26592 (UCRL-50021-71(Rev.1)) LASER-FUSION PROGRAM SEMIANNUAL REPORT, JULY–DECEMBER 1971. Kachen, G. I. Jr.; Clements, W. (eds.) (California Univ., Livermore. Lawrence Livermore Lab.). 11 Feb 1972. Contract W-7405-eng-48. 101p. Dep. NTIS $3.00.

Laser research and development programs dealing with solid-state, gas, and chemical lasers are described. Some experimental and theoretical studies of laser-produced plasmas are briefly reviewed. (MOW)

26593 (WASH-1239) FUSION POWER: AN ASSESSMENT OF ULTIMATE POTENTIAL. (Division of Controlled Thermonuclear Research (AEC), Washington, DC). Feb 1973. 62p. GPO $0.90.

The ultimate potential of fusion power was appraised by considering a set of reference designs for full-scale fusion reactors. The four major fusion concepts considered are the tokamak, theta pinch, magnetic mirror, and laser fusion systems. Descriptions of environmental characteristics of the devices during normal operation are given. (MOW)

26594 MICRO-FISSION EXPLOSIONS AND CONTROLLED RELEASE OF THERMONUCLEAR ENERGY. Winterberg, F. (Univ. of Nevada, Las Vegas). Nature (London); 241: No. 5390, 449-450(16 Feb 1973).

The possibility of igniting a thermonuclear micro-explosion by a laser pulse has recently attracted great interest as a result of the proposal to lower the energy requirements by imploding a T–D thermonuclear pellet with a laser pulse of proper shape, thereby increasing its density by a factor of $\sim 10^4$ over the solid density. If this concept of high-density compression is applied to a fissionable pellet consisting of ^{235}U, ^{233}U or ^{239}Pu, very small critical masses become possible. These critical masses can be further reduced by surrounding the fissionable pellet with a neutron reflecting material to be compressed, together with the pellet, to high densities. Finally, if this neutron-reflecting material consists of thermonuclear material such as T–D, the fission chain reaction in the critical pellet will ignite a small thermonuclear explosion in the neutron reflector. The fission chain reaction rises at a much faster rate than for solid densities because of the greatly increased densities. The release of thermonuclear neutrons in the reflector will accelerate the fission chain reaction to an even higher speed whereby the heating of the thermonuclear material is accelerated, resulting in even more thermonuclear neutrons. The system may be useful as a small fission power plant, especially for a safe breeder reactor or as a combined fission-fusion power plant. Another important application of this concept is for space propulsion. (auth)

26595 PULSED NEUTRON SOURCE. Josephson, V. (To Secretary of the United States Air Force). U. S. Patent 3,715,595. 6 Feb 1973. Filed date 11 May 1970. 6p.

An apparatus for producing neutrons having a base portion, an energy source, and a pair of uniquely designed electrodes, one of which is at least partially of titanium, is described. These electrodes are shaped so as to cause a tri-dimensional compression on the plasma or ionized gas within this apparatus. The tri-dimensional compression, in conjunction with the titanium electrode, provides for higher temperatures and neutron yields than were heretofore possible. (Official Gazette)

26596 RESISTOR FOCUSING OF THE INJECTED ELECTRONS IN THE ASTRON. Christofilos, N. C.; Langdon, A. B.; Porter, G. D.; Rensink, M. E. (Lawrence Livermore Laboratory, University of California, Livermore, California 94550). J. Appl. Phys. 44: No. 2, 660-661 (Feb 1973).

The net axial focusing force for a non-neutral cylindrical E layer in various Astron resistor configurations is calculated. There is strong focusing for cases in which there are resistors on the cantilever. (auth)

26597 PROMISE OF CONTROLLED THERMONUCLEAR POWER. Drummond, W. E. (Univ. of Texas, Austin). Ashrae (Amer. Soc. Heat., Refrig. Air-Cond. Eng.) J.; 15: No. 2, 34-36 (Feb 1973).

A survey is given of fusion control techniques to date. The Texas tokamak is briefly described. (MOW)

Wave Phenomena

26598 (AREAEE-151) EFFECT OF HIGH-FREQUENCY PRESSURE ON BEAM–PLASMA INTERACTION IN BOUNDED SYSTEMS. Demchenko, V. V.; El-Siragy, N. M. (Atomic Energy Establishment, Cairo (Egypt). Dept. of Accelerators and Plasma Physics Research). 1972. 33p. Dep. NTIS (U. S. Sales Only) $3.75.

Excitation of electromagnetic waves in a plane-parallel plasma layer by a monoenergetic low-density electron beam was studied when plasma particles are acted upon by high-frequency pressure of the field. Dispersion equations that differ essentially from those of linear theory were obtained. High-frequency pressure was shown to make the electromagnetic field oscillate over the layer cross section or decrease from the boundaries to its center, even under conditions of skin effect. Under conditions of linear skin effect, the field has surface nature and may efficiently interact with electron beams. Thus, one may conclude that the account of high-frequency pressure of the field may lead to the disappearance of the beam–plasma interaction and, thereby, to the disappearance of surface instability. The expressions for increase were obtained in the case of coherent excitation of surface waves by electron beams, uniform and nonuniform over their transversal cross section. (auth)

26599 (IPP-IV-51) ACCESSIBILITY TO THE LOWER HYBRID RESONANCE. Puri, S.; Tutter, M. (Max-Planck Institut fuer Plasmaphysik, Garching (West Germany)). Jan 1973. 15p. Dep. NTIS (U. S. Sales Only) $3.00.

Accessibility of a plane electromagnetic wave into an inhomogeneous, magnetized plasma column is studied, using the complete cold plasma dielectric tensor. It is found that TM (transverse magnetic) waves incident at small angles with the vacuum–plasma interface are almost completely transmitted into the plasma, even though the criterion for accessibility to the lower-hybrid resonance is not satisfied. The significance of this result for coupling rf energy into plasma-filled waveguides is discussed. (auth)

26600 (IPPJ–128) NONLINEAR MODULATION OF PLASMA WAVES. Kako, M. (Nagoya Univ. (Japan). Inst. of Plasma Physics). Jun 1972. 37p.

Nonlinear modulation of waves in a cold plasma is investigated with a modification of a perturbation method developed by Taniuti and Yajima. In particular, it is shown that a modulated electron-cyclotron wave is influenced by a slow motion of the plasma and that there is a critical wave number for the onset of modulational instability. The critical wave number is found to be independent of the direction of propagation, i.e., $k_{crit} = \omega_{pe}/c\sqrt{3}$, where ω_{pe} and c are the plasma frequency and the light velocity, respectively. A lower hybrid wave, which propagates perpendicular to a uniform magnetic field, is shown to be stable against the wave modulation and, in the limit of small wave number, the modulated wave is an oscillatory solution of the Korteweg–de Vries equation obtained by Gardner and Morikawa. (auth)

26601 (JUL-895-TP) COHERENT RESPONSE OF A PLASMA TO LINEAR WAVE FIELDS. Helrich, C. S. (Kernforschungsanlage, Juelich (West Germany). Institut fuer Technische Physik). Oct 1972. 32p. Dep. NTIS (U. S. Sales Only) $3.75.

Using only the field equations, the total energy equation for slightly damped linear waves in a fully ionized plasma is derived. In addition to the electromagnetic energy and Poynting vector, this equation contains energy and energy flux terms arising from the coherent response of the plasma to the wave fields. By performing an expansion of the particle energy equations about the undamped condition, expressions are obtained for these terms containing well-defined particle functions. The coherent energy consists of both a hydrodynamic and a thermal contribution, and the coherent flux involves the transport of thermal energy by perturbation and diffusion currents as well as viscous terms. (auth)

26602 (NOAA-TM-ERL-AL-5) LABORATORY INVESTIGATIONS OF DRIVEN LOW-FREQUENCY PLASMA OSCILLATIONS. Yadlowsky, E. J.; Goldan, P. D. (National Oceanic and Atmospheric Administration, Boulder, Colo. Environmental Research Labs.). Jan 1973. Contract AT(49-8)-3006. 16p. Dep. NTIS $3.00.

This work is directed toward exciting and identifying the parametric decay instability in an unmagnetized plasma. In the course of this work, it has been found that low-frequency os-

cillations can be excited by applying rf potentials in conjunction with dc potentials to grids immersed in the plasma, in addition to the well-known oscillations excited with dc potentials alone. Some of the low-frequency oscillations excited exhibit the characteristics of ion-acoustic waves associated with excitation of the parametric decay instability; however, the characteristics of all the oscillations are similar and are thought to be the same phenomenon excited by different techniques. The report is divided into an experimental section followed by three sections that discuss the three general categories of low-frequency oscillations that have been excited in an unmagnetized plasma. (MOW)

26603 (ORO-4338-1) NONLINEAR ELECTROSTATIC ION WAVES. Nine-Month Progress Report, May 1, 1972–February 1, 1973. Jones, W. D. (University of South Florida, Tampa (USA). Dept. of Physics). 1 Feb 1973. Contract AT(40-1)-4338. 33p. Dep. NTIS.

Two basically different experiments were done and one new Langmuir probe circuit was developed. The first experiment involved the free expansion of a neutral plasma. This technique, which can be used to produce a $\Delta n/n$ having a wide range of values from $\ll 1$ to $\gg 1$, was used to produce a plasma flow which can be considered either as an extremely nonlinear ion acoustic wave or as a shock wave. The main results of this study were to show that: (1) the leading edge of the stream propagates at a speed of approximately three times the speed of a linear ion acoustic wave, in good agreement with nonlinear theory; and (2) that a strong low-frequency turbulence develops behind the propagating density step, mainly in the region of initial penetration, which persists for long times. The second experiment is considered with the nonlinear coupling of electromagnetic and ion acoustic waves. A preliminary theory that includes a density gradient, plasma loss by diffusion, and the Doppler shift due to drifting ions, indicates that the growth and decay behavior of the ion acoustic waves are produced directly by the density gradient itself. An experiment to study the effects of large-amplitude rf fields on linear waves is presently underway. The next step will be to study the nonlinear coupling between ion waves and two anti-parallel propagating electromagnetic waves whose frequency and wavenumber differences, $\Delta\omega$ and Δk, satisfy the ion-wave dispersion relation. The new Langmuir probe circuit is a simple circuit for automatic sweeping of the probe voltage with scope display of the results. The circuit is made completely of passive circuit elements and is adjustable for minimizing phase shifts normally introduced in automatic probe circuits. A feedback loop is designed to make the probe operable even in the presence of large-amplitude rf fields. This technique has been developed specifically to allow one to monitor continuously the electron temperature variation occurring during the rf and nonlinear three-wave interaction experiments. (auth)

26604 (TRITA-EPP-72-34) EXPERIMENTS ON MAGNETO-ACOUSTIC OSCILLATIONS IN A ROTATING PLASMA WITH SUPERIMPOSED hf HEATING. Bures, M.; Tennfors, E. (Kungliga Tekniska Hogskolan, Stockholm (Sweden)). Dec 1972. 34p. Dep. NTIS (U. S. Sales Only).

Radial magnetoacoustic eigenoscillations are excited in a rotating plasma to investigate the possibilities to use the frequency and damping time for diagnostics. Experiments are carried out with hydrogen and deuterium plasmas. In both cases the energy balance is varied by means of superimposed high-frequency heating. The relation between the oscillation characteristics and macroscopic plasma parameters is studied theoretically for an infinitely long cylindrical plasma shell, both in the homogeneous case and when the temperature is allowed to vary across the plasma. It is shown that the eigenfrequency of the oscillations is a measure of the mass density and the geometry of the hot fully ionized plasma core. The damping time is determined by the cool partly ionized boundary regions and cannot easily be interpreted in terms of the temperature of the core. However, it is clear from the results that the damping time increases considerably when the high-frequency heating is applied. Thus both the frequency and the damping time of the eigenoscillations can be used to study the energy balance of the plasma. (auth)

26605 ION-CYCLOTRON-WAVE GENERATION IN A TWO-ION PLASMA. Toyama, H.; Matsuura, K. (Nagoya Univ., Japan). Nucl. Fusion; 13: No. 1, 63-68(Jan 1973).

Exact calculation of the dispersion relation of a cold plasma shows that the plasma behavior is different from that predicted by the usual approximate theory which neglects electron inertia in the low-density limit. For example, the limiting value of Ω for optimum coupling is different from 1, where Ω is the wave frequency divided by the ion cyclotron frequency. This fact ascertained experimentally in the QP-machine. Experimental observations of optimum coupling of the ion cyclotron wave in a two-ion plasma in the QP machine are presented as functions of the plasma density. The plasma was produced by a PIG discharge with a density from 10^{10} to 2×10^{12} cm^{-3}. The wave was generated by a Stix-type coil (coil wavelength 50 cm), which was fed by a 4.4-MHz, 20-kW oscillator. Experimental data lay within the band of H^+ concentration between 10 and 90% of the dispersion relation of a homogeneous cold plasma column with a sharp boundary. However, the dependence of optimum loading on the diameter of the plasma column disagrees with the theoretical prediction. (auth)

26606 PARAMETRIC EXCITATION OF CIRCULARLY POLARIZED AND ION WAVES IN A MAGNETIZED PLASMA. Lee, K. F. (National Oceanic and Atmospheric Administration, Boulder, CO). Phys. Lett.; 43A: No. 1, 77-78(12 Feb 1973).

Threshold intensities and growth rates are calculated for the parametric decay instability in which a circularly polarized pump wave excites a low-frequency electrostatic ion wave and an electromagnetic circularly polarized wave in a magnetized plasma. (auth)

26607 BUILDUP OF A NARROW PLASMA CHANNEL BY MICROWAVES. Musil, J.; Zacek, F. (Inst. of Plasma Physics, Prague). Czech. J. Phys.; 22: No. 11, 1108-1112(1972).

The effect was studied of the buildup of a narrow plasma channel by a hf right-hand circularly polarized (RHCP) wave propagating through radially inhomogeneous plasma in the direction of the static magnetic field. The plasma channel occurs under conditions when the linear transformation of the RHCP wave takes place. The experiments were carried out in a homogeneous static magnetic field $\omega_{ce}/\omega \simeq 2.3$; ω, ω_{ce} are the frequency of the RHCP wave and the electron cyclotron frequency, respectively. (auth)

26608 THREE-WAVE INTERACTION IN TURBULENT PLASMAS. Tsytovich, V. N. (Lebedev Inst. of Physics, Moscow); Stenflo, L. Phys. Lett., A; 43A: No. 1, 7-8(12 Feb 1973).

A new possibility for enhancement of three-wave interaction processes is pointed out. This could be of interest for plasma heating by means of high-frequency radio waves as well as by laser radiation. (auth)

26609 PROPAGATION OF BACKWARD SURFACE WAVE ALONG AN ANNULAR PLASMA GUIDE WITH AZIMUTHAL ELECTRON DENSITY VARIATION. Nonaka, Shigehiko; Akao, Yasuo (Department of Electrical Engineering, Nagoya University, Nagoya, Japan). J. Appl. Phys. 44: No. 2, 644-652 (Feb 1973).

The effect of azimuthal variation of electron density on the surface-wave propagation along the inner surface of an annular plasma column is described experimentally and analytically. Such inhomogeneity of electron density is induced by the earth's magnetic field, which is not parallel to the direction of electron drift along the column axis. In this case the azimuthal distribution of electric field intensity of the surface wave is distorted, and the dipole mode, which is normally degenerate, splits into two modes with different wave numbers. The field distortion becomes more intense as the inhomogeneity increases and the wavelength decreases. The theoretical analysis shows that the distortion results from the coupling between normal modes by the effect of the inhomogeneity. Experiments are carried out by using a mercury-vapor-discharge tube with hot cathode, and the results agree well with the calculations. (auth)

PHYSICS (RADIATION AND SHIELDING)

Radiation Physics

26610 (LA-5114) HEX: A ONE-DIMENSIONAL CODE FOR COMPUTING X-RAY ABSORPTION. Gardner, S. D.; Seitz, W. L. (Los Alamos Scientific Lab., N. Mex.). Feb 1973. Contract W-7405-eng-36. 34p. Dep.

A FORTRAN code, HEX, is described for computing x-ray absorption and heating in one-dimensional, multilayered absorbers. The numerical treatment includes the effects of photoelectric capture, coherent and incoherent scattering, and incorporates a geometric model of scattering which permits corrections for back-scattered radiation and scattering losses from the periphery of disk-shaped absorbers. The intended applications are to x-ray heating problems requiring the absorption in numerous mesh cells for input into hydrodynamic or heat transfer codes. Interaction energies up to 5 MeV can be treated, although the validity of the results is limited to photon energies for which scattering effects are not excessive ($\lesssim$200 to 300 keV). Comparisons of HEX with a Monte Carlo photon transport code employing essentially identical cross sections yielded agreement normally within ~5% for intermediate or high-Z materials and to within 10 to 15% for the lower-Z materials. (auth)

26611 (ORNL-TM-4110) GENERAL SENSITIVITY THEORY FOR RADIATION TRANSPORT. Oblow, E. M. (Oak Ridge National Lab., Tenn.). Mar 1973. Contract W-7405-eng-26. 28p. Dep. NTIS.

The theoretical framework of a general approach to sensitivity analysis using adjoint functions is introduced and developed for practical application. Sensitivity and the context in which it is used is defined quantitatively in terms of adjoint functionals. The physical meaning and applicability of such a definition are then discussed with reference to both analytic and predictive studies. Connections are made between the general approach and perturbation theory for predictive applications. Specific formulations useful in cross-section sensitivity work are described in detail. (auth)

26612 METHOD OF DETERMINING NUCLEAR RADIATION ABSORPTION BY RESIDUAL ACTIVITY MEASUREMENTS. Hensel, F. (Kernforschungsanlage, Juelich, Ger.). Phys. Status Solidi (a); 15: No. 2, 473-476(16 Feb 1973).

A method is described by which it is possible to measure the absorption coefficient of nuclear radiation without the usual application of foils or thin layers, electroplated or evaporated onto a radioactive source. The method is based on the measurement of the residual activities of a specimen homogeneously alloyed with a radioisotope. As an example, the β-ray absorption of ^{10}Be in beryllium was measured. It is shown that the absorption coefficient determined in this way is just that which is required for diffusion measurements by application of the residual activity method or the surface-counting technique. (auth)

26613 DISTRIBUTION OF BACKSCATTERED GAMMA RAY PHOTONS IN THE SCATTERING MEDIUM. Preiss, K.; Livnat, R. (Negev Inst. for Arid Zone Research, Beer Sheba). Nucl. Eng. Des.; 24: No. 2, 258-262(1973).

Monte Carlo calculations were performed to simulate the behavior of photons scattered back from a semi-infinite medium. The source considered was point isotropic on the surface of the medium, and the media simulated soils of various densities. The values of the number albedo obtained agreed well with those quoted in the literature. The radial distribution was found to fall off exponentially, with a dependence on distance from the source practically independent of source energy and material, provided the photoelectric absorption cross section at the source energy is negligible. This conclusion is supported by calculation from results quoted in the literature. The distributions of the initial direction cosine relative to the radius joining source and point of exit, and of the number of scatters, were calculated and tabulated. (auth)

26614 INVESTIGATION OF SPECTRA OF BACKSCATTERED BETA PARTICLES. Szepke, R. (Instytut Badan Jadrowych, Warsaw). Nukleonika; 17: No. 7/8, 361-367(1972). (In Polish).

Backscattered spectra of beta particles and energy fluxes of such radionuclides as ^{90}Sr + ^{90}Y, ^{204}Tl and ^{147}Pm were investigated by using a special hollow plastic scintillator. Significant variations in the mode values of the spectra were observed as a function of the scattering material and geometry used. The results obtained are plotted in figures. (auth)

26615 CALCULATION OF THE ABSORBED DOSE AND DOSE EQUIVALENT FROM NEUTRONS AND PROTONS IN THE ENERGY RANGE FROM 3.5 GeV TO 1.0 TeV. Armstrong, T. W.; Chandler, K. C. (Oak Ridge National Lab., TN). Health Phys.; 24: No. 3, 277-286(Mar 1973).

Nucleon-meson cascade calculations were carried out for monoenergetic neutrons and protons in the energy range from 3.5 GeV to 1.0 TeV normally incident on a semi-infinite slab of tissue 30 cm thick. The absorbed dose and dose equivalent as a function of tissue depth are presented, and analytic expressions for the resulting maximum and average fluence-to-absorbed-dose and fluence-to-dose-equivalent factors are given as a function of incident neutron or proton energy. The calculations were performed by using Monte Carlo methods in conjunction with theoretical nuclear-interaction models. (auth)

26616 LARGE-ANGLE K X-RAY PRODUCTION BY ELECTRONS. Dick, C. E.; Lucas, A. C.; Motz, J. M.; Placious, R. C.; Sparrow, J. H. (National Bureau of Standards, Washington, D.C. 20234). J. Appl. Phys. 44: No. 2, 815-826 (Feb 1973).

Experimental values are given for the yields and spectral energy purities of K x-ray beams emitted at 120° and 180° from various targets when bombared by 0.01- to 3.0-MeV electron beams. Yields and purities are determined for beryllium, carbon, aluminum, titanium, copper, silver, and gold targets as a function of the target thickness and target inclination angle. (auth)

Radiation Protection Standards

26617 INTERACTION OF TERMINOLOGY AND POLICY IN DEFINING RADIATION STANDARDS. Dunster, H. J. (National Radiological Protection Board, Harwell, Eng.). Radiol. Prot. Bull.; No. 1, 7-11(1972).

The terminology and inter-relationships of the various radiation standards are briefly discussed in general terms, with reference to the U. K. and U. S. A. Particular reference is made as to how the relationship between the terms depends on their differing purposes, and on the policy decisions of the body concerned, e.g. ICRP, IAEA etc. Consideration is given to Maximum Permissible Dose, Dose Limit, derived working limits and discharge limits. (UK)

26618 PROPOSED UNIT FOR PATIENT RADIATION EXPOSURE FROM DIAGNOSTIC X-RAYS. Jennings, W. A. (National Physical Lab., Teddington, Eng.). Health Phys.; 24: No. 4, 445-446(Apr 1973).

Reference is made to the proposal by Cameron (Health Phys.; 21: 879(1971)) that a new unit for patient exposure from diagnostic X-rays, the roentgen-area-product (rap), be defined, where 1 rap = 100 R cm^2. It is considered that such a quantity is not desirable for several reasons; a unit (roentgen) should not be mixed with a quantity (area), the interpretation of measurements with an area-exposure product meter entails the assumption that all the X-ray beam transmitted by the meter is incident on the patient, and even if the latter assumption was correct it would still be difficult to relate the measurement to the average radiation received by the gonads, bone marrow and the skin as suggested by the ICRP. Nevertheless there is value in the use of area-exposure product meters in training fluoroscopy operators to restrict both X-ray beam size and fluoroscopic time. However since such readings can be expressed in terms of R cm^2 it is considered wrong to endow the quantity with yet another named quantity. (UK)

26619 STRUCTURE AND FUNCTIONS OF THE EUROPEAN ECONOMIC COMMUNITIES IN RELATION TO RADIOLOGICAL PROTECTION. Richings, L. D. G. (National Radiological Protection Board, Harwell, Eng.). Radiol. Prot. Bull.; No. 2, 3-10 (Jan 1973).

An outline is given of the structure of the Commission of the European Communities and the way in which it functions and will develop in relation to applying standards of radiological protection, and in the promotion and financing of research in the radiobiological field. The need is stressed for up to the minute appreciation of the policies, procedures, relationships within the communities and methods of working. It is pointed out that particularly during the initial period of the United Kingdom's membership, papers written on the subject could be misdirected, wrong in emphasis, or factually wrong by the time they are in print. (UK)

Shielding Calculations and Experiments

Refer also to abstract 27149.

PHYSICS (SOLID-STATE)

26620 VOPROSY OBSHCHEI I PRIKLADNOI FIZIKI. Trudy Vtoroi Respublikanskoi Konferentsii, Alma-Ata, USSR, 20-24 Oktyabrya 1969 g. (Problems in General and Applied Physics. 2nd Republic Conference, Alma-Ata, USSR, October 20-24, 1969). Genkin, Ya. E. (ed.). Alma-Ata, USSR; Izdatel'stvo Nauka Kazakhskoi SSR (1972). 252p. (CONF-691072-).

From 2nd republic conference on problems in general and applied physics; Alma-Ata, USSR (20 Oct 1969).

This volume contains 74 conference papers submitted by various authors in the fields of the physics of metals, semiconductors, dielectrics, transfer phenomena, optical and x-ray spectroscopy, and spectral analysis. Several papers are concerned with the electronic structure of solid substances, plastic materials, diffusion phenomena, and structural analysis. A number of papers consider the effects of ionizing radiations on metals and alloys. Individual abstracts were prepared for seven selected papers. (KSW)

For abstracts of individual papers see: 26026, 26646, 26647, and 26683–26686.

Radiation Effects

Refer also to abstracts 24679, 24768, 24787, and 25249.

26621 (AECL-4375) PRODUCTION, DETECTION, AND ANNEALING OF CRYSTAL LATTICE POINT DEFECTS IN NEUTRON IRRADIATION OF CERAMIC MATERIALS. Dienst, W. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Material und Festkoerperforschung). Translation of KFK-1215. Feb 1973. 98p. Dep. NTIS (U. S. Sales Only) $7.00.

Ways of treating theoretically the defects in the crystal lattice caused by neutron irradiation are described. The situation in binary lattices is briefly dealt with. The description outlines the production of point defects and displacement spikes by collision processes as well as the corresponding lattice-site exchanges and the site exchanges due to ionization and temporary overheating in the neighborhood of fission-fragment paths. Also considered are the point-defect concentration in equilibrium between defect production and recovery and the formation of point-defect clusters. A survey is given of experimental results in the literature on lattice defects by neutron irradiation in nonfissile ceramic materials. The large number of results for the light-metal oxides BeO, MgO, Al_2O_3 is supplemented by data on transition-metal carbides, SiC, Mo, and LiF. Comparison of all data suggests a dependence of the maximum lattice expansion on the type of lattice bonding. The lattice expansion increases in the sequence of metallic → ionic → covalent bond. Conversely, the saturation dose depends mainly on the atomic weight of the lattice atoms. For compounds of atoms with intermediate atomic weights, it is lower by approximately one decimal order of magnitude compared to compounds of light atoms. These trends were confirmed by x-ray-diffraction analysis carried out on irradiated powder specimens of ZrO_2 (cubic stabilized), ZrN, and ZrC. The specimens were irradiated below 150°C with neutron fluences up to $\sim 5 \times 10^{19}$ fast n/cm^2 or uranium fission fragments up to 7 to 10×10^{17} f/cm^3. Lattice expansion was nearly saturated after the indicated neutron fluence. It increased in the sequence ZrO_2, ZrN, ZrC. After fission-fragment irradiation the differences of lattice expansions between the different Zr compounds were smaller than after neutron irradiation. These differences were attributed to differently ordered states of point-defect clusters depending on the type of lattice bonding. For fission fragment irradiation, a thermal recovery effect by the thermal rods (along the fission fragment paths) improves the ordered state of clusters. Powdered UN and UC were examined after irradiation below 150°C up to fission densities of 4×10^{20} f/cm^3 at the maximum. The lattice expansion and distortion with increasing fission density in UN are similar to that in UO_2, but they are characterized by stronger irradiation effects and higher specific fission densities. In UN the formation of large ordered point-defect clusters is more difficult than in UO_2 owing to the predominant covalent metal/nonmetal bond. Lattice expansion and distortion in UC show a course essentially different from that in UN. This may be due to a relatively weak metal/nonmetal bond which facilitates the formation of point-defect clusters in the partial lattices of UC. After a maximum linear lattice expansion of 2.1×10^{-3} after $\sim 5 \times 10^{17}$ f/cm^3, a reversion of lattice expansion down to slightly negative values was observed for UN at higher fission densities. This was attributed to different overlapping volumes for vacancy core and interstitial-atom zone of the displacement spikes. Irradiated Zr and U compounds were subjected to 2-h annealings at steps of 100°C. After each step, the recovery of lattice expansion and distortion was measured. Recovery took place in temperature ranges which are related to the melting point. Steps of accelerated recovery of lattice expansion occurred at $\sim 0.15-0.2\ T_M$ and $0.3-0.35\ T_M$. They can be attributed to the migration of isolated interstitial atoms and vacancies, respectively. Finally, an estimation is given of the enhancement of diffusion processes in the lattice caused by the increase in point defect concentration and the lattice-site exchange-frequency under irradiation. The estimate shows that a measurable increase in the diffusion rate can be expected especially for ceramic fuels. It could possibly result in an enhancement of diffusion-induced creep which might be described with a modified Nabarro–Herring model. 27 figures, 90 references. (DLC)

26622 (INR-1443) NEUTRON SPECTRAL MEASUREMENTS IN A NECK TISSUE PHANTOM. Filipiak, B. (Institute of Nuclear Research, Warsaw (Poland)). 1972. 20p. Dep. NTIS (U.S. Sales Only) $3.00.

Method and results of neutron spectral measurements in the neck tissue phantom using the activation detectors were described. Taking Denis's calculation of conversion factors, distribution of absorbed dose rate in phantom was established. This work was mainly done at Scottish Research Reactor Centre, Gr. Britain. (auth)

26623 THERMAL CONDUCTIVITY OF NEUTRON-IRRADIATED MgO. Kupperman, D. S.; Kurz, G.; Weinstock, H. (Illinois Inst. of Tech., Chicago). J. Low Temp. Phys.; 10: No. 1-2, 193-201(Jan 1973).

The thermal conductivity of pure and neutron-irradiated MgO was measured at 0.4 to 80°K and for fast neutron doses up to 2×10^{19} n·cm^{-2}. Resonance dips in the thermal conductivity vs temperature curves are observed at 1 and 20°K. It is suggested that the high-temperature dip, which becomes more pronounced with increasing radiation dose, may be a quasilocalized mode resulting from the production of F-type centers. The low-temperature dip, which fades with increasing neutron dose, may result from the presence of small aggregate centers which give rise to another set of quasilocalized modes. The experimental data for the pure and irradiated crystals are in agreement with calculated curves based on the Debye model of solids. A combined relaxation time for the calculated curves of the irradiated specimens includes a term for the defect scattering rate consisting of two resonance expressions of the Lorentzian form. (auth)

26624 HARDENING OF KBr BY HEAVY γ IRRADIATION AT LNT. Naramoto, H. (Japan Atomic Energy Research Inst., Tokai); Ozawa, K.; Okada, T.; Suita, T. Phys. Lett., A; 43A: No. 2, 95-96(26 Feb 1973).

The anomalous enhancement of the flow stress was observed in KBr heavily irradiated at LNT by gamma ray. The enhancement is closely related to the growth of the intrinsic component in the V_4-envelope. (auth)

26625 STUDY OF NEUTRON-IRRADIATED VITREOUS SILICA BY OPTICAL SCATTERING. Prod'homme, L.; Calvo de Fernandez, M. L. (CNRS, Paris). Verres Refract.; 26: No. 4, 132-137 (Jul 1972). (In French).

The light-scattering method was employed to determine the shape, size, and concentration of defects in various types of vitreous silica induced by neutron irradiation doses ranging from 10^{17} to 10^{18} n/cm^2. The influence of glass impurities on the damage caused and on the recovery after heat treatment was determined. The results show that the damaged areas have the shape of small rods of about 1000 Å in length; they are oriented at random and their concentration increases with the irradiation dose received. The OH ions content has no noticeable effect on the size of the defects but the presence of metallic impurities seems to increase their length. For all the types of silica examined, the decrease in damage after heat treatment did not occur below 600°C. In excess of 1000°C, the sensitivity of the method is a minimum. It is therefore not possible to assess whether the recovery is complete below the vitreous transition temperature. (France)

26626 EXOELECTRON ENERGY MEASUREMENTS ON K_2SO_4 AFTER X-RAY IRRADIATION AND ELECTRON BOMBARDMENT. Brunsmann, U. (Univ., Giessen, Ger.). Phys. Status Solidi (a); 15: No. 2, 525-532(16 Feb 1973).

A four-electrode retarding field arrangement and a method of measurement are described that allow to determine the exoelec-

tron energies and to control the sample charging simultaneously. High vacuum investigations on K_2SO_4 powder show that the exoelectron energy is independent of time during afteremission up to 90 min. It is influenced, however, by small accelerating fields, sample charging, optical stimulation energy, temperature variation, and especially by changing the sorption parameters. (auth)

26627 DOSE BEHAVIOR OF DILUTE Al(Mg) ALLOYS NEUTRON IRRADIATED AT 4.6K. Mayer, H. (Technische Univ., Munich); Boening, K.; Dimitrov, C.; Dimitrov, O. Phys. Status Solidi (a); 15: No. 2, K91-K94(16 Feb 1973).

The effects of Mg additions (200 and 1000 atomic ppM) on the rate of resistivity increase during neutron irradiation at 4.6°K were studied. At low dose, the rate increases monotonously with Mg content; this effect vanishes with increasing dose. The possible explanation of this effect in terms of size effect, Matthiessen's rule deviations, and enhanced defect production is discussed. (DLC)

26628 STAGE-I RECOVERY IN PREQUENCHED ELECTRON-IRRADIATED MOLYBDENUM. Rizk, R.; Vajda, P.; Lucasson, A.; Lucasson, P. (CNRS, Orsay, France). Phys. Status Solidi (a); 15: No. 2, K105-K107(16 Feb 1973).

Molybdenum specimens were quenched from 1700 to 1950°C and then irradiated by 1.7-MeV electrons at 7°K before being subjected to isochronal anneals. Comparison of the results for unquenched and quenched samples shows that the peaks at 14–15°K, 33°K, and 40°K decrease after quenching, while the 20–30°K and 48°K peaks increase with quenching. Thus, quenching has an effect similar to that of increased electron energy. The implications of the results in terms of collision sequences and defocusing are discussed. (DLC)

26629 COLOR CENTERS IN $SrCl_2$. den Hartog, H. W.; Mollema, P.; Schaafsma, A. (Solid State Physics Lab., Groningen, Netherlands). Phys. Status Solidi (b); 55: No. 2, 721-728(1 Feb 1973).

Experimental results are reported obtained on additively and substractively colored $SrCl_2$ crystals. By means of combined optical and ESR experiments, the position of the F band could be located. It was found that O^{2-} impurities play an important role in the additive and substractive coloration process. The presence of O^{2-} ions very strongly enhances the coagulation rate of electron-excess centers formed during additive coloration. Models for radiation damage processes in O^{2-}-doped $SrCl_2$ crystals are discussed. (auth)

26630 SUBSTRATE CURRENTS WITH ION-BEAM SPUTTERING. Fiedler, O.; Weise, H. (Technische Hochschule, Karl Marx-Stadt, Ger.). Exp. Tech. Phys.; 20: No. 3, 211-219(1972). (In German).

Measuring currents of charged particles at the substrate position during ion-beam sputtering with the combinations $Ar^+ \rightarrow$ Cu, $Kr^+ \rightarrow$ Cu, and $Kr^+ \rightarrow$ Mo yielded ratios of positive with respect to negative particles and to neutral ones of 0.008 and 0.014, respectively. They confirmed that Mo, having the lower sputtering rate, emits secondary ions with higher energy. Investigations on the influence of sputtering pressure on substrate currents in 6×10^{-6} to 6×10^{-5} torr range showed a fourfold increase of the positive and negative currents with pressure. Supposing this effect is due to ionization in a gas layer adsorbed on the target surface, estimations show the right order of magnitude. In this case, one monolayer was assumed to be the maximum covering. (auth)

26631 ION SPUTTERING AND ITS APPLICATIONS FOR PRODUCTION OF DIELECTRIC AND SEMICONDUCTOR FILMS IN MICROELECTRONICS. Fiedler, O.; Hecht, G.; Weissmantel, C. (Technische Hochschule, Karl-Marx Stadt, Ger.). Exp. Tech. Phys.; 20: No. 3, 197-209(1972). (In German).

Recent work on plasma sputtering ameliorated the process productivity and improved the quality of the sputtered films. Special attention was aimed at the origin and avoidance of defects in thin insulating films: Pre-etching the substrates or deposition under conditions of high reemission allows a reduction of film porosity. Development on ion-beam sputtering showed an increase of sputtering power at improved vacuum conditions. Thin silicon layers on quartz and spinel substrates produced this way, however, are perceptibly contaminated by Ta, W, and Cu, according to microanalysis and some electrical parameters of the films. Structural investigations showed single-crystal growth on spinel substrates above 800°C. (auth)

26632 ION-IMPLANTED BIPOLAR TRANSISTOR CARRIER CONCENTRATION PROFILES. Barnoski, M. K.; Loper, D. D. (Hughes Research Labs., Malibu, CA). Solid-State Electron.; 16: No. 4, 433-440(Apr 1973).

The investigation of ion implantation as a dopant process for the fabrication of narrow base-width (1000 Å) n–p–n microwave (5 to 10 GHz) bipolar transistors was made. The performance of a bipolar transistor is intimately related to the impurity dopant distribution in the emitter and base regions of the device. Ionized impurity profiles were determined by making Hall effect and resistivity measurements as a function of dopant layer thickness. The profiles of arsenic, phosphorus, and boron were investigated in this matter. The phosphorus layers were formed both by diffusion and implantation, while only ion-implanted boron and arsenic layers were measured. (auth)

26633 MICROWAVE CHARACTERISTICS OF ION-IMPLANTED BIPOLAR TRANSISTORS. Barnoski, M. K.; Loper, D. D. (Hughes Research Labs., Malibu, CA). Solid-State Electron.; 16: No. 4, 441-451(Apr 1973).

The fabrication and analysis of all ion-implanted, epitaxial silicon, n–p–n bipolar microwave transistors is discussed. The dopants used to form the emitter and base regions are ion implanted arsenic and boron, respectively. The arsenic was implanted at 150 keV with $1 \times 10^{16}/cm^2$; the boron was implanted at both 50 keV with $8 \times 10^{13}/cm^2$ and 20 keV with $4 \times 10^{13}/cm^2$. Structures with 2-μm emitter widths and 3-μm emitter-base spacings were fabricated and their S parameters experimentally determined. The experimental maximum oscillation frequency f_{max} was found to be 6.0 GHz as compared to 6.4 GHz, computed utilizing a T-equivalent circuit and device circuit parameters obtained using known geometry and concentration profiles. A thorough description of the processing sequence used in the fabrication is given. (auth)

26634 PbS PHOTODIODES FABRICATED BY Sb^+ ION IMPLANTATION. Donnelly, J. P.; Harman, T. C.; Foyt, A. G.; Lindley, W. T. (Massachusetts Inst. of Tech., Lexington). Solid-State Electron.; 16: No. 4, 529-534(Apr 1973).

N/p junction photodiodes in PbS were fabricated using Sb^+ ion implantation to create the n-type layer. At 300°K, 15-mil-square diodes have shown typical zero-bias resistances of 200 Ω corresponding to a resistance-area product of 0.28 Ω-cm^2. At 195°K the zero-bias resistance increased to 50 kΩ for a resistance-area product of 70 Ω-cm^2, and at 77°K the zero-bias resistance was 5×10^9 Ω for a resistance-area product of 7×10^6 Ω-cm^2. Peak detectivities occurred at 2.55, 2.95, and 3.4 μm at 300, 195, and 77°K, respectively. The corresponding measured detectivities were 4.8×10^9, 1.1×10^{11}, and 4.2×10^{12} cm $Hz^{1/2}/W$. The 77°K detectivity was measured in a reduced background and was amplifier noise-limited. Peak quantum efficiencies were typically 50 to 60%. (auth)

26635 LUMINESCENCE OF PROTON-IRRADIATED β-SiC. Nesterov, A. A.; Gurko, V. D.; Smirnov, L. S. (Inst. of Semiconductor Physics, Novosibirsk, USSR). Sov. Phys.-Semicond. (Engl. Transl.); 6: No. 7, 1130-1133(Jan 1973).

Translated from Fiz. Tekh. Poluprov.; 6: No. 7, 1292-1295 (Jul 1973).

Results are given of an investigation of the cathodoluminescence of β-SiC irradiated with 1.5-MeV protons. The heavy-particle bombardment was responsible for several features such as an increase in the proportion of large defects with increasing dose and with increasing depth of the disturbed region. This bombardment was also responsible for a fall in the intensity and for the broadening of the zero-phonon lines of the defect luminescence in strongly disordered regions. The results of annealing up to 1250°C and quenching from 2500 to 3000°C are reported, and measurements of the microhardness and microbrittleness of crystals bombarded with 3.5-MeV electrons are described. It is concluded that large defects can also form as a result of electron bombardment. (auth)

26636 OPTICAL PROPERTIES OF NEUTRON-IRRADIATED SILICON. Koval, Yu. P.; Mordkovich, V. N.; Temper, E. M.; Kharchenko, V. A. Sov. Phys.-Semicond. (Engl. Transl.); 6: No. 7, 1152-1155(Jan 1973).

Translated from Fiz. Tekh. Poluprov.; 6: No. 7, 1317-1322(Jul 1972).

Measurements were made of the infrared absorption in n- and p-type silicon irradiated with large neutron doses (~10^{19} cm^{-2}) at 60 and about 250°C. Isochronous annealing was carried out in the range 100 to 800°C. The crystals irradiated at the lower temperature and annealed at 350 to 600°C exhibited not only the known nonselective absorption at the band edge (2 to 4 μ) and the absorption in the 17 to 25-μ region, but also absorption in the 4.5 to 14.5-μ region, where more than 20 separate peaks were observed after annealing at 500°C. In the samples irradiated at the higher temperature the 2 to 4 and the 17 to 25-μ regions were transparent, and the absorption in the 4.5 to 14.5-μ region was observed immediately after irradiation. In this case the absorption in the

4.5 to 14.5-μ region was strongest after annealing at 450°C. Two components of the absorption associated with the vibrational spectrum and with electron transitions were identified and the absorption itself was attributed to defects in the form of disordered regions. (auth)

26637 ANNEALING OF RADIATION-INDUCED DEFECTS IN P-TYPE GERMANIUM SAMPLES. Basman, A. R.; Gerasimov, A. B.; Dolidze, N. D.; Kakhidze, N. G.; Konovalenko, B. M. (Ioffe Inst. of Physics and Tech., Leningrad). Sov. Phys.-Semicond. (Engl. Transl.); 6: No. 7, 1222-1223(Jan 1973).

Translated from Fiz. Tekh. Poluprov.; 6: No. 7, 1398-1399(Jul 1972).

A study was made of the recovery of carrier lifetime τ during annealing of p-type and n-type Ge irradiated with 4-MeV electrons at 77°K. The restoration of τ begins above 350°K, and a considerable part of the recovery takes place above 420°K, where the recovery of the carrier density is already complete. It is concluded that the restoration of τ in both p-type and n-type Ge is due to the disappearance of acceptor levels from annealing of the radioinduced defects, and that in p-type Ge a high concentration of acceptors still remains which is fully annealed only at 570°K. (DLC)

26638 INFLUENCE OF COPPER ON THE KINETICS OF ANNEALING OF RADIATION DEFECTS IN GERMANIUM. Gerasimov, A. B.; Dolidze, N. D.; Kasparyan, K. I.; Kakhidze, N. G.; Konovalenko, B. M.; Mtskhvetadze, M. G. (Ioffe, Inst. of Physics and Tech., Leningrad). Sov. Phys. Semicond. (Engl. Transl.); 6: No. 8, 1368-1371(Feb 1973).

Translated from Fiz. Tekh. Poluprov.; 6: No. 8, 1587-1590 (Aug 1972).

An investigation was made of the annealing of radiation defects in n- and p-type germanium doped with antimony, gallium, and copper. The impurity concentrations in n-type samples were $N_{Sb} = 3.8 \times 10^{14}$ cm^{-3} and $N_{Cu} = (4.7$ to $8.6) \times 10^{13}$ cm^{-3}, whereas the corresponding concentrations in p-type samples where $N_{Ga} = 1 \times 10^{15}$ cm^{-3} and $N_{Cu} = 5 \times 10^{15}$ cm^{-3}. These samples were irradiated at T = 77°K with 4.5-MeV electrons. The presence of copper in n-type samples resulted in a shift (toward lower temperatures) of the "reverse-annealing" and the electron-density-recovery stages. A similar shift of the hole-density-recovery stage and the absence of this stage at high temperatures were observed for p-type samples. These effects were attributed to an additional annihilation of vacancies resulting from their interaction with copper atoms displaced to interstitial positions by the irradiation-generated interstitial germanium atoms. (auth)

26639 SPATIAL DISTRIBUTION OF RADIATION DEFECTS IN SILICON IRRADIATED WITH BORON AND PHOSPHORUS IONS. Kumakhov, M. A.; Muralev, V. A. (Moscow State Univ.). Sov. Phys.-Semicond. (Engl. Transl.); 6: No. 8, 1350-1354(Feb 1973).

Translated from Fiz. Tekh. Poluprov.; 6: No. 8, 1564-1570 (Aug 1972).

The range of B, N, Al, P, As, and Ga ions and the straggling of B and P ions are calculated for silicon. Simple approximation equations are derived for the range of B and P. The range and straggling of B and P ions are used to calculate the distributions of radiation defects generated by B and P ions in silicon. This calculation is carried out for a wide range of ion energies. The case of irradiation of an oriented target, when the channeling effect is important, is also considered. (auth)

26640 FORMATION OF DISORDERED LAYERS IN ION BOMBARDMENT OF CRYSTALS. Romanov, S. I.; Smirnov, L. S. (Inst. of Semiconductor Physics, Novosibirsk, USSR). Sov. Phys.-Semicond. (Engl. Transl.); 6: No. 8, 1410-1411(Feb 1973).

Translated from Fiz. Tekh. Poluprov.; 6: No. 8, 1631-1634(Aug 1972).

An electron diffraction study was made of the formation of disordered layers in Si during bombardment by 100-keV Ar^+ and 40-keV Ne^+ and B^+ ions. Values were derived for the dose of complete surface and bulk amorphization. The heaviest ion used, Ar^+ causes amorphization within the crystal, while the lightest ion, B^+, forms an amorphous layer initially at the surface. (DLC)

26641 IRRADIATION OF OXIDE-COATED SILICON WITH LOW-ENERGY CHARGED PARTICLES. Vologdin, E. N.; Zhukova, G. A.; Mordkovich, V. N. Sov. Phys.-Semicond. (Engl. Transl.); 6: No. 7, 1143-1146(Jan 1973).

Translated from Fiz. Tekh. Poluprov.; 6: No. 7, 1306-1310 (Jul 1972).

The influence of irradiation with hydrogen, boron, and phosphorus ions ($E \leq 60$ keV) on the properties of surface layers in silicon was investigated, and the charge Q_s of the Si/SiO_2 interface was determined. The value of Q_s was found to depend on the relationship between the thickness of the oxide film and the range of the incident ions as well as on the nature of these ions. The radiation effects at the Si/SiO_2 interface could not be explained by ionization alone, as is usually assumed. The spectrum of the energy levels and the annealing temperature were determined for the defects generated near the surface of silicon by bombardment with protons ($E_v + 0.10$ eV, $E_c - 0.16$ eV), boron ions ($E_v + 0.06$ eV, $E_v + 0.10$ eV), and phosphorus ions ($E_c - 0.05$ eV, $E_c - 0.10$ eV, $E_c - 0.16$ eV). The $E_c - 0.16$ levels generated by proton bombardment were associated with A centers. (auth)

26642 γ-IRRADIATION EFFECTS IN FERROELECTRIC KDP. Gonzalo, J. A.; Nazario, I. (Puerto Rico Nuclear Center, Mayaguez). J. Phys. Chem. Solids; 34: No. 5, 921-922(May 1973).

Results are given for the effects of γ-irradiation on the dielectric constant and transition temperature of potassium dihydrogen phosphate (KDP), at various radiation doses, at liquid N_2 temperature. The results confirm those of Tokumoru et al. (Japan J. Appl. Phys., 9: 1548(1970)) for the dielectric constant. The temperature variation of the hysteresis loops of irradiated samples provided information on both coercive field and spontaneous polarization. A comparison is made of the radiation effects on KDP and on other hydrogen-bonded ferroelectrics. (UK)

26643 POSITRON LIFETIMES IN PROTON-IRRADIATED SILICON. Cheng, L. J.; Yeh, C. K. (Inst. of Nuclear Energy Research, Taipei, Taiwan). Solid State Commun.; 12: No. 6, 529-531(15 Mar 1973).

Substantial extensions of the shorter of two positron lifetimes in p-type silicon upon irradiation with 5.7-MeV protons were observed, showing that some induced defects can act as traps for positrons. The mean electron density of the defect was found to be about 30% less than that in the perfect part of the crystal. The result demonstrates that the positron-lifetime measurements is a useful tool for studying defects in semiconductors. (auth)

26644 VOIDS IN STAINLESS AUSTENITIC STEEL X18H10T AFTER IRRADIATION IN THE BR-5 FAST REACTOR. Reutov, V. F.; Farkhutdinov, K. G.; Ladygin, A. Ya. Fiz. Metal. Metalloved.; 34: No. 4, 816-821(1972). (In Russian).

An electron microscope was used to investigate the effect of various conditions of irradiation to the point of "swelling" of austenitic steel X18H10T following irradiation in the BR-5 reactor. An increase in the size of the cavities and a decrease in their density occurred in the interval 430 to 510°C. It is suggested that a portion of the voids was filled with hydrogen. (tr-auth)

26645 INFLUENCE OF SUBSTRATE AND METALLIC FILM ON THE ANNEALING OF RADIATION DEFECTS CAUSED BY PROTON BOMBARDMENT. Chechetenko, V. V.; Tishchenko, L. P.; Peregon, T. I.; Seryugin, A. L.; Fogel, Ya. M.; Martyunov, I. S. (Physical-Technical Inst. of Low Temperatures, Kharkov). Fiz. Metal. Metalloved.; 34: No. 4, 858-861(1972). (In Russian).

A comparison was made of the character of radiation defect annealing in Ag films deposited on a mica support, and in free films of various grain types and sizes. Since the grain size did not alter the annealing process, it was concluded that the grain boundaries were not the essential outlet for the radiation defects in the films tested. (KSW)

26646 INVESTIGATION OF ION DISTRIBUTION IN DIAMOND BY THE (p,γ) REACTION. Katsaurov, L. N.; Krasnopevtsev, V. V.; Milyutin, Yu. V.; Nusupov, K. Kh. pp 107-110 of Voprosy Obshchei I Prikladnoi Fiziki. Genkin, Ya. E. (ed.). Moscow; Izdatel'stvo Nauka Kazakhskoi SSR (1972). (In Russian)

From 2nd republic conference on problems in general and applied physics; Alma-Ata, USSR (20 Oct 1969). See CONF-691072-.

The concentration profile of ^{7}Li embedded in natural diamond was studied by bombarding diamond in the direction of the ⟨111⟩ crystal axis at room temperature with 43-keV Li ions from an electromagnetic separator. The path length of Li in diamond was evaluated using the reaction ^{7}Li(p,γ)^{8}Be (resonance capture of protons by ^{7}Li nuclei). The "half-depth" of penetration was 700 Å, with the maximum concentration of ^{7}Li lying near the surface. (tr-auth)

26647 INFLUENCE OF REACTOR RADIATION ON SOME PHOTOELECTRIC PROPERTIES OF SINGLE CRYSTALS. Putiev, I. T. pp 118-120 of Voprosy Obshchei i Prikladnoi Fiziki. Genkin, Ya. E. (ed.). Moscow; Izdatel'stvo Nauka Kazakhskoi SSR (1972). (In Russian)

From 2nd republic conference on problems in general and applied physics; Alma-Ata, USSR (20 Oct 1969). See CONF-691072-.

A study was made of the effect of reactor radiation on the

photosensitivity and spectral distribution of photoconductivity of single crystals of ZnS activated by Ag. A dose of 10^{17} neutrons/cm^2 lowered the photoconductivity of the ZnS/Ag from 0.3×10^{-7} ohm/cm (unirradiated) to 0.8×10^{-9}. Crystals which had been exposed to 10^{18} n/cm^2 did not react to light. The photoconductivity spectrum exhibited a change; the maximum decreased with neutron exposure. (tr-auth)

26648 LOCAL- AND DEFECT-MODE INFRARED ABSORPTION OF CARBON IONS IMPLANTED IN SILICON. Vaidyanathan, K. V. (Department of Electrical Engineering, University of Waterloo, Waterloo, Ontario, Canada). J. Appl. Phys. 44: No. 2, 583-586 (Feb 1973).

Infrared-absorption measurements on carbon-implanted silicon are reported. A localized vibrational mode for substitutional carbon has been observed in annealed samples and in samples implanted at 500 °C. The results suggest that between 40 and 60% of the implanted ions occupy substitutional sites. A broad absorption band which shifts to shorter wavelength on annealing has been observed and is attributed to the formation of SiC microcrystals. Absorption bands at 1097, 750, 640, and 625 cm^{-1} have been observed in pulled crystals. It is suggested that these bands arise due to the presence of carbon-oxygen complexes formed during implantation. (auth)

26649 ION CHANNELING STUDIES OF THE CRYSTALLINE PERFECTION OF EPITAXIAL LAYERS. Picraux, S. T. (Sandia Laboratories, Albuquerque, New Mexico 87115). J. Appl. Phys. 44: No. 2, 587-593 (Feb 1973).

Ion channeling and backscattering of 450- to 1340-keV protons were used to study the crystalline perfection of heteroepitaxial Si layers of thicknesses between 1 and 3 μm. An approximate calculation of the dechanneling background was used to obtain the depth profiles of crystalline imperfections in the epitaxial layers. Both the plural scattering theories of Meyer and Keil et al. were used in the calculation and are shown to give similar profiles. Channeling measurements as a function of sample temperature, beam energy, and layer removal were used to check the self-consistency of the analysis. Analysis of these measurements for a given sample gave the same depth profile ($\pm$20%) confirming the validity of the technique. The technique provides a convenient evaluation of epitaxial layers containing large numbers of crystalline imperfections. (auth)

26650 PROPERTIES OF A SINGLE-LEVEL SURFACE STATE INDUCED BY Be IMPLANTATION INTO Si–SiO_2 INTERFACES. Fahrner, W.; Goetzberger, A. (Institut für Angewandte Festkörperphysik der Fraunhofer-Gesellschaft, Freiburg i. Br., Germany). J. Appl. Phys. 44: No. 2, 725-727 (Feb 1973).

Be ions implanted in an Si–SiO_2 interface constitute the first measured single—level surface state at $E_c - E = 0.70$ eV. Time constant dependence on surface potential was in good agreement with theory. Capture cross sections were determined $\sigma_p = 10^{-13}$ cm^2 for holes and $\sigma_n = 10^{-10}$ cm^2 for electrons. The Be ions form an efficient recombination center. (auth)

26651 CORRELATION OF ION CHANNELING AND ELECTRON MICROSCOPY RESULTS IN THE EVALUATION OF HETEROEPITAXIAL SILICON. Picraux, S. T.; Thomas, G. J. (Sandia Laboratories, Albuquerque, New Mexico 87115). J. Appl. Phys. 44: No. 2, 594-602 (Feb 1973).

The crystalline quality of heteroepitaxial (100) and (111) Si layers on spinel or sapphire substrates has been investigated using ion channeling and electron microscopy. Ion channeling and backscattering give the depth profile of the density of imperfections, and electron microscopy is used to determine the nature of the imperfections as well as give an additional determination of their density. Transmission electron microscopy indicates that stacking faults and microtwins are the dominant types of imperfections in the layers, and these defects are interpreted to be the primary source of scattering centers for the channeled ions. Both channeling and scanning electron microscopy measurements indicate that the density of imperfections decreases with increasing distance from the interface. At equal distances from the interface a lower density of imperfections was observed in the Si layer for (111) Si/spinel and (100) Si/sapphire as compared to (100) Si/spinel. Large differences in the rate of decrease of the density of imperfections were observed for (100) Si/sapphire from different suppliers. The interpretation of the influence of the fault planes on channeling has been achieved by modeling the scattering by these defects. Semiquantative correlations of scattering center densities from electron microscopy and channeling measurements indicate higher absolute densities for the channeling results, while relative densities determined at various depths by these two techniques are in agreement. (auth)

26652 GRAIN BOUNDARY FRICTION IN COPPER SUBJECTED TO NEUTRON IRRADIATION AND FATIGUE. Strible, Fred C. (Hughes Tool Company, Aircraft Division, Culver City, California 90230); Cady, James R. J. Appl. Phys. 44: No. 3, 1050-1055 (Mar 1973).

The grain boundary friction of pure (99.999%) annealed, polycrystalline copper has been investigated as a function of neutron irradiation and fatigue. Neutron irradiation was found to suppress the magnitude of the grain boundary peak as observed by measurements of internal friction. This result is attributed to inhibited grain boundary movement caused by the interaction between irradiation-generated defects and the grain boundaries. After intensive irradiation, the grain boundary peak is completely eliminated. Fatigue also suppressed the magnitude of the grain boundary peak. The fatigue effect is attributed both to reduced grain boundary viscosity, and to peak broadening caused by an increased spectrum of relaxation times. The effects of neutron irradiation and fatigue appear to be additive at the lower levels of irradiation. However, after intensitive irradiation, fatigue causes the material to soften, probably by mechanisms similar to those causing fatigue softening of cold worked materials. The latter effect is reflected in a large increase in background friction and restoration of a slight grain boundary peak. (auth)

Physical Properties

Refer also to abstracts 24327, 25109, 25240, 26026, and 26272.

26653 (CONF-720221-(Vol.14C)) PROCEEDINGS OF THE NUCLEAR PHYSICS AND SOLID STATE PHYSICS SYMPOSIUM, BOMBAY, FEBRUARY 1–4, 1972. Volume 14C. Solid State Physics. (Department of Atomic Energy, Bombay (India). Physics Committee). 1972. 676p.

From Nuclear physics and solid state physics symposium; Bombay, India (1 Feb 1972).

A total of 138 papers and abstracts are arranged into sections dealing with: low-temperature behavior of solids and liquids, electronic properties of solids, thermal and dynamical properties of solids and liquids, and magnetic properties of solids. Separate abstracts were prepared for eleven of the papers; two of the remaining were previously abstracted as NSA 26: 16835 and 49259. (DLC)

26654 (CONF-720404(Vol.4), pp 2342-2348) CRYSTAL FIELD SPLITTING OF THE ATOMIC CORE $p_{\frac{1}{2}}$ LEVELS. Gupta, R. P. (International Centre for Theoretical Physics, Trieste, Italy); Sen, S. K. (Univ. of Manitoba, Winnipeg). Jan 1973.

From Proceedings of the international conference on inner shell ionization phenomena and future applications; Atlanta, Georgia (17 Apr 1972).

In Proceedings of the international conference on inner shell ionization phenomena and future applications.

The splittings of the atomic core $p_{\frac{1}{2}}$ levels due to internal electric field gradients have been calculated for the case of Tm^{3+} ions in thulium ethyl sulphate and shown to be measurable by photoelectron spectroscopy. The splittings could be about 1 eV under favorable conditions. (auth)

26655 (CONF-730402-9) MAGNETIC PROPERTIES OF ^{147}Pm AND ^{147}Pm–^{147}Sm ALLOYS. Koehler, W. C.; Moon, R. M. (Oak Ridge National Lab., Tenn.). Jan 1973. 9p. Dep. NTIS $3.00.

From 10th rare earth research conference; Carefree, Arizona, USA (30 Apr 1973).

Neutron scattering experiments were carried out on a polycrystalline rod of ^{147}Pm (2.2% Sm and 11% Sm) at temperatures ranging from 320 to 7.5°K. The double hexagonal close-packed structure characteristic of Pr and Nd was observed over this temperature range for both compositions. Evidence for magnetic ordering in ^{147}Pm was sought. From conventional measurements, any ordered moment must be less than about 0.4 μ_B. Neutron depolarization measurements indicate a small ferromagnetic moment at low temperatures and a transition temperature near 98°K. Polarized neutron measurements of one of the Bragg peaks indicate that this moment is less than about 0.03 μ_B. These observations are not consistent with point-charge model crystal-field calculations which predict a doublet ground state for ions on both hexagonal and cubic sites. (auth)

26656 (CONF-730402-10) MAGNETIC INTERACTIONS AND SPIN-WAVE DISPERSION IN RARE-EARTH METALS. Nicklow, R. M. (Oak Ridge National Lab., Tenn.). Jan 1973. 11p. Dep. NTIS $3.00.

From 10th rare earth research conference; Carefree, Arizona, USA (30 Apr 1973).

Results of neutron scattering measurements of the spin-wave dispersion relations for Gd, Dy, Ho, and Er metal are reviewed. From these measurements, information about the exchange and anisotropy interactions in heavy rare-earth metals is obtained. For all these metals the exchange interaction is found to be extremely long-range, and in ferromagnetic Dy direct evidence that the exchange continues to favor a helical structure is found. Ex-

cepting perhaps Gd, anisotropy interactions in addition to the usual crystal field and magneto-elastic interactions are required in order to give a satisfactory description of the data. In particular, the results for Er show that anisotropic exchange can be a dominant interaction in rare earth metals. (auth)

26657 (CONF-730402-11) SPIN DENSITIES IN RARE-EARTH METALS AND COMPOUNDS. Moon, R. M. (Oak Ridge National Lab., Tenn.). Jan 1973. 10p. Dep. NTIS $3.00.

From 10th rare earth research conference; Carefree, Arizona, USA (30 Apr 1973).

The usual procedure in magnetic structure determination by neutron diffraction is reversed in order to obtain experimental form factors and to find details of the magnetization density in a single atomic volume. Gd is chosen because the orbital contribution vanishes and the 4f magnetization, spin, and charge densities are all identical. Magnetic scattering amplitudes are compared with nonrelativistic calculations of Freeman and Watson, and satisfactory agreement is obtained between experiment and theory for the 4f electron radial density. The excess scattering is believed to be associated with conduction spin polarization; density maps in real space show positive density at each atomic site and negative density in the region between atoms. For Sm, magnetic scattering amplitudes for cubic sites are compared with calculations, and the total moment per atom is believed to be 0.15 ± 0.05 μ_B with the following components: a 4f orbital moment of 3.42 μ_B, a 4f spin moment of -2.85 μ_B, and a conduction spin moment of -0.42 μ_B. Crystal-field effects are considered; predicted form factors for TmSb for fields along ⟨100⟩ and ⟨110⟩ are in agreement with experimental results. (DLC)

26658 (COO-3331-4) ULTRASONIC ATTENUATION STUDIES OF THE ELECTRONIC STRUCTURE OF METALS. Progress Report, June 1, 1972–May 31, 1973. Hoffman, A. R. (Massachusetts Univ., Amherst). [nd]. Contract AT(11-1)-3331. 14p. Dep. NTIS $3.00.

The experimental measurements of ultrasonic attenuation and magnetization in the mixed state of niobium have been completed. Measurements of beryllium's thermal conductivity as a function of temperature and magnetic field were begun. Data are presented for the 1 to 20°K region. (14 references) (DLC)

26659 AMORPHOUS METALLIC FILMS FOR BUBBLE DOMAIN APPLICATIONS. Chaudhari, P.; Cuomo, J. J.; Gambino, R. J. (IBM Watson Research Center, Yorkstown Heights, NY). IBM J. Res. Develop.; 17: No. 1, 66-68(Jan 1973).

It was found that sputtered amorphous films of Gd–Co and Gd–Fe have perpendicular magnetic anisotropy. The demagnetized domain configuration consists of stripe domains, and bubble domains were nucleated in an applied field. By controlling the sputtering conditions, films with a wide variety of magnetic properties were obtained. (auth)

26660 THERMOELECTRIC POWER OF SOME ThCe ALLOYS. Cooper, J. R. (Univ., Zagreb); Rizzuto, C. J. Low Temp., Phys.; 10: No. 1-2, 207-215(Jan 1973).

Measurements of thermoelectric power were made on some ThCe alloys in the temperature range 2 to 300°K. A modified version of the Nordheim–Gorter rule was used to obtain the contribution from scattering by the Ce atoms. The results up to 70°K can be understood in terms of the model of nonmagnetic 4f states in agreement with other recent work on this alloy system. (auth)

26661 EQUILIBRIUM DISTRIBUTION COEFFICIENT IN DILUTE BINARY SOLUTIONS. Moser, Z. (Inst. for Metal Research, Krakow). Bull. Acad. Pol. Sci., Ser. Sci. Tech.; 20: No. 9, 743-749(1972).

Consideration of the equilibrium between the solid and liquid phases in relation to phase diagrams of binary systems and thermodynamic properties of dilute liquid solutions, assuming that solid solutions are regular, enabled the calculation of the equilibrium distribution coefficients $k_{0(Zn)}$ and $k_{0(Cd)}$ in the Zn–Cd and Cd–Pb solutions. It has been demonstrated that in determining the equilibrium distribution coefficients an essential role is played by the limiting values of the activity coefficients of the admixture for the solid and liquid states, respectively; especially in the vicinity of the melting point of the solvent. The values obtained $k_{0(Zn)}$ and $k_{0(Cd)}$ on the thermodynamic basis assume similar values as those calculated directly from the equilibrium diagrams at temperatures close to melting point of the solvent. (auth)

26662 CONTRIBUTION OF 5d ELECTRONS TO THE SATURATION MAGNETIC MOMENTS AND MAGNETIC HYPERFINE FIELDS IN THE HEAVY RARE EARTH METALS. Eagles, D. M. (Commonwealth Scientific and Industrial Research Organization, Sydney). Solid State Commun.; 12: No. 4, 291-294(15 Feb 1973).

The main results of a model for 5d electrons in the heavy rare earth metals are presented. The model involves the use of wave functions based on published analyses for $4f^n5d6s^2$ atomic configurations, and the spreading of each of these energy levels uniformly over a band of width W in the metals. Excess saturation magnetic moments above those of the tripositive ions can be explained by the model with W in the range 0.84 ± 0.16 eV in the five metals Gd, Tb, Dy, Er, and Tm. The magnetic hyperfine fields in the metals include negative contributions from the 5d electrons which have been shown to amount to about –250 kOe in Gd, Er, and Tm. (auth)

26663 EXPLANATION FOR THE α-PEAK IN HYDROGENATED NIOBIUM. Buck, O. (North American Rockwell Corp., Thousand Oaks, CA); Thompson, D. O.; Wert, C. A. J. Phys. Chem. Solids; 34: No. 4, 591-595(Apr 1973).

Recent experiments have shown that nucleation and growth of niobium hydrides at the $\alpha/\alpha + \beta$ solvus is indicated by the growth of an internal friction maximum (α peak). This internal friction maximum has a height proportional to the hydrogen concentration; its position shifts progressively to higher temperatures with increasing hydrogen concentration, and its activation energy is about 0.27 eV. An acoustical loss mechanism which seems to account for this internal friction maximum is discussed. This mechanism is based upon the thermal generation of kinks on punched-out dislocation; its application to this problem is suggested by two observations. They are: (1) punched-out dislocation loops surround the hydride precipitate, and (2) the maximum is characterized by the same activation energy as the α peak in slightly deformed pure niobium. A semi-quantitative calculation based on this mechanism yields the observed increase in peak magnitude and the temperature shift of the peak with increasing hydrogen concentration. It is shown that a consistent set of dislocation parameters (the density and the loop length) is obtained. (auth)

26664 GROUND STATE OF THE U^{5+} ION IN $CsUF_6$ AND ITS PARAMAGNETIC SUSCEPTIBILITY. Mulak, J.; Zolnierek, Z. (Inst. of Low Temperatures and Structure Research, Wroclaw). Bull. Acad. Pol. Sci., Ser. Sci. Chim.; 20: No. 11-12, 1081-1086 (1972).

The paramagnetic susceptibility of $CsUF_6$ at 1.5 to 400°K is reported. Eigenfunctions of the ground doublet of the U^{5+} ion in $CsUF_6$ were found by simultaneous diagonalization of the matrix of spin–orbit coupling and ligand field interaction including trigonal distortion of UF_6^- octahedron. Exceptionally small magnitude of the temperature dependent part of the paramagnetic susceptibility of this doublet was explained. (auth)

26665 STUDIES ON THE V_2O_5–MoO_3 SYSTEM: OPTICAL AND IR SPECTRA. Bielanski, A.; Dyrek, K.; Kozlowska-Rog, A. (Jagellonian Univ., Krakow). Bull. Acad. Pol. Sci., Ser. Sci. Chim.; 20: No. 11-12, 1055-1062(1972).

Optical spectra of samples belonging to the V_2O_5–MoO_3 system were investigated at 200 to 1000 nm by the reflection technique. Pure oxides show distinct absorption edge below 550 nm in V_2O_5 and 450 in MoO_3. In both cases it is contributed to the electron transfer from the valence to the conduction band. The introduction of MoO_3 into the V_2O_5 lattice results in darkening and a distinct increase in the absorption coefficient. This change is probably connected with the increasing concentration of V^{4+} ions and electrons in the conduction band. Ir spectra were obtained using samples mixed with KBr and pressed into pellets. In the range of solid solution of MoO_3 in the V_2O_5, a shift of the 1025 cm^{-1} peak (stretching vibrations of the double bond V=O) towards lower frequencies is observed. The introduction of molybdena into V_2O_5 lattice contributes therefore to a weakening of the double bond V=O which may be of some importance for the catalytic properties of the V_2O_5–MoO_3 system. (auth)

26666 POSITRON ANNIHILATION IN COPPER SINGLE CRYSTALS. Senicki, E. M. D. (Atomic Energy of Canada Ltd., Pinawa, Manitoba); Becker, E. H.; Gould, A. G.; West, R. N.; Hogg, B. G. J. Phys. Chem. Solids; 34: No. 4, 673-677(Apr 1973).

A point-geometry angular correlation measurement of the annihilation radiation from an annealed single crystal of copper is presented. The results are compared with results for an unannealed sample and theoretical predictions obtained from a simple picture of the electronic wave functions combined with two models for the positron wave function. (auth)

26667 RELAXATION OF NONEQUILIBRIUM CONDUCTIVITY OF β RHOMBOHEDRAL BORON. Szadkowski, A. (Inst. of Physics, Warsaw). Phys. Status Solidi (a); 15: No. 2, K95-K97(16 Feb 1973).

The nonequilibrium (excess) conductivity produced by rapid cooling (immersion in liquid toluene) in B was studied as a function of

time at temperatures from 210 to 245°K. The relaxation time τ at 210°K was ~10 h, and τ depends exponentially on reciprocal temperature, with an activation energy of 0.63 eV. The relaxation is similar to that of photoconductivity. (DLC)

26668 ELECTRONIC STRUCTURE OF TRANSITION METAL OXIDES AND SOME OF THEIR CHEMOSORPTIVE AND CATALYTIC PROPERTIES. Chirulescu, T. (Center for Physical Chemistry, Bucharest). Stud. Cercet. Chim.; 20: No. 8, 945-955 (Aug 1972). (In Rumanian).

The characteristic features of catalytic phenomena on the surface of transition metal oxides are reviewed, considering crystal defects, superficial reactivity, and chemosorption of gases at the surface. The study included examination of the hydrogen–deuterium isotopic exchange reaction. It was found that the specific activity of the $H_2 + D_2 \rightleftharpoons 2HD$ reaction depends on the nature of the metal oxide used as catalyst. The reaction exhibits two maxima, one for Cr_2O_3 and another for Co_3O_4. A certain parallelism was established between the catalytic activity of the isotopic exchange reaction and the corresponding activity of the dehydrogenation reaction of cyclohexene and propane. These maxima were attributed to the completion of the coordination sphere of a superficial cation. The effect of various cobalt ferrites, $Co_{3-x}Fe_xO_4$ with x = 1.93, 1.98, 2.02, and 2.07, on the course of the isotopic exchange reaction was also examined; it was found that the reaction occurs in two stages, the first of which the activation of the surface. The kinetic data revealed that the reaction rate depends on the stability of the superficial chemical complexes. (27 references) (TTT)

26669 INFLUENCE OF OXYGEN ADSORPTION CENTERS UPON THE EXOELECTRON EMISSION OF BeO. Euler, M.; Kriegseis, W.; Scharmann, A. (Univ., Giessen, Ger.). Phys. Status Solidi (a); 15: No. 2, 431-440(16 Feb 1973).

A method is given to study the effect of various adsorbed gases on the thermally and optically stimulated exoelectron emission of BeO. Oxygen adsorption centers are found to be exoactive. Their influence is discussed with respect to the electronic properties of the surface and to possible exoelectron emission mechanisms. An additional glow peak after several ways of pretreatment indicates that conversions of the adsorption centers take place. (auth)

26670 MAGNETIC PROPERTIES AND ORDERED STRUCTURE OF TM_3 COMPOUNDS OF RARE EARTHS WITH INDIUM AND TIN. Lethuillier, P.; Pierre, J.; Fillion, G.; Barbara, B. (CNRS, Grenoble, France). Phys. Status Solidi (a); 15: No. 2, 613-620 (16 Feb 1973). (In French).

The magnetic properties of TIn_3 and TSn_3 compounds were studied in magnetic fields up to 320 kOe. They present metamagnetism and spin-flopping phenomena. Neutron-diffraction studies show that the ordered structure is determined by a propagation vector (½, ½, 0) in TIn_3 compounds and (½, 0, 0) in TSn_3 compounds. (auth)

26671 ELECTRICAL PROPERTIES OF NbO IN HIGH MAGNETIC FIELDS. Honig, J. M.; Wahnsiedler, W. E.; Eklund, P. C. (Purdue Univ., Lafayette, IN). J. Solid State Chem.; 6: No. 2, 203-212(Feb 1973).

The resistivity and Hall coefficients of polycrystalline samples, single crystals, and doped specimens of $NbO_x(0.98 \leq x \leq 1.02)$ were measured in magnetic fields up to 160 kG at 4.2, 78, and 295°K. The material is found to be an excellent conductor. The results are interpreted in terms of a nearly free-electron model in which holes and electrons contribute jointly to conduction processes. Orbital switching, magnetic breakdown effects, and perturbations arising from impurities are invoked to explain the observed magnetoresistance anomalies. (auth)

26672 METAL–INSULATOR TRANSITION IN V_nO_{2n-1}. Kachi, S.; Kosuge, K.; Okinaka, H. (Kyoto Univ.). J. Solid State Chem.; 6: No. 2, 258-270(Feb 1973).

Research on phase relationships and structure studies by electron diffraction confirm V_nO_{2n-1} (n = 3–9) phases between V_2O_3 and VO_2. Metal–insulator phase transitions have been found in all phases but V_3O_5 and V_7O_{13}. Electrical, magnetic, and thermodynamic properties associated with the transitions are reported for sintered samples or for single crystals prepared by a vapor-transport method. The results are collated and reviewed in summarized form. (14 figures, 46 references) (auth)

26673 ENERGY BAND STRUCTURE OF CADMIUM. Ramchandani, M. G. (Bhabha Atomic Research Centre, Bombay). pp 49-53 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Bombay, February 1-4, 1972. Bombay; Dept. of Atomic Energy (1972).

26674 MODEL FOR A DISORDERED SYSTEM: NATURE OF ELECTRONIC STATES. Krishan, K. (Tata Inst. of Fundamental Research, Bombay). pp 55-59 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Bombay, February 1–4, 1972. Bombay; Dept. of Atomic Energy (1972).

26675 SAXON–HUTNER THEOREM IN THE RELATIVISTIC DOMAIN. Bhagwat, K. V.; Subramanian, R. (Bhabha Atomic Research Centre, Bombay). pp 61-64 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Bombay, February 1-4, 1972. Bombay; Dept. of Atomic Energy (1972).

26676 HIGH-PRESSURE RESISTIVITY MEASUREMENTS ON VANADIUM-RUTHENIUM ALLOYS. Viswanathan, B. (Indian Inst. of Science, Bangalore, India); Govindarajan, K.; Jayaraman, A. pp 149-154 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Bombay, February 1–4, 1972. Bombay; Dept. of Atomic Energy (1972).

26677 LATTICE DYNAMICS OF BERYLLIUM. Thaper, C. L.; Rao, K. R.; Roy, A. P. (Bhabha Atomic Research Centre, Bombay). pp 289-292 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Bombay, February 1-4, 1972. Bombay; Dept. of Atomic Energy (1972).

26678 TEMPERATURE DEPENDENCE OF THE SPIN-LATTICE RELAXATION TIME IN LAVES-PHASE RARE-EARTH INTERMETALLICS. Bajaj, M. M.; Soni, S. K.; Saha, N. K. (Univ. of Delhi). pp 605-609 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Bombay, February 1-4, 1972. Bombay; Dept. of Atomic Energy (1972).

26679 ELECTRONIC STRUCTURE OF THE TERNARY ALLOYS $V_3(Ge_{1-y}Ga_y)$ AND $V_3(Ge_{1-y}Al_y)$. Surikov, V. I.; Pryadein, V. I.; Shtol'ts, A. K.; Stepanov, A. P.; Prekul, A. F.; Gel'd, P. V. (Ural Polytechnic Inst., Sverdlovsk, USSR). Fiz. Metal. Metalloved.; 34: No. 4, 724-728(1972). (In Russian).

The temperature–concentration dependencies of the magnetic susceptibility, Knight shift, coefficient of the absolute thermo-emf, and the concentration dependence of the electric resistivity and transition temperature were measured in the superconducting alloys $V_3(Ge_{1-y}Ga_y)$,and $V_3(Ge_{1-y}Al_y)$. These alloys were solid solutions with the A15-type crystal lattice. (tr-auth)

26680 LOW-TEMPERATURE ELECTRICAL RESISTIVITY OF α-CERIUM UNDER PRESSURE. Nicolas-Francillon, M. (Centre National de la Recherche Scientifique, Meudon Bellevue, France); Jerome, D. Solid State Commun.; 12: No. 6, 523-526 (15 Mar 1973).

A new method is used to study the α phase of cerium without inclusions of β phase, based on the use of hydrostatic pressure. Measurements of transport properties performed on α and γ phase in the pressure domain 0 to 8.5 kbar and down to 1.3°K are reported. A pressure-independent low-temperature resistivity is observed. Exchange enhancement effects on transport properties, previously observed in high-pressure susceptibility experiments, were not detected. (auth)

26681 CHARACTER OF THE CHEMICAL BOND IN METAL-LIKE COMPOUNDS BASED ON TRANSITION METALS. Rzyanin, B. F. (Moscow Wood-Technology Inst.). Fiz. Metal. Metalloved.; 34: No. 4, 709-713(1972). (In Russian).

A method is proposed for determining the electron state of interstitial atoms (H,B,C, and N) in metal-like compounds of the transition metals. The statistical Thomas–Fermi model and the Wigner–Seitz method were used to calculate lattice parameters and bond energies for the following compounds: ZrH, NbH, TiB, ZrB, TiC, ZrC, NbC, VC, ThC. Conclusions based on these results were drawn concerning their principally metallic character. (tr-auth)

26682 NUCLEAR GAMMA RESONANCE STUDY OF THE INFLUENCE OF HYDROGEN ON THE ELECTRONIC STRUCTURE OF IRON ATOMS IN THE LAVES-PHASE $ZrFe_2$. Rudnev, I. I.; Bykov, V. N.; Shcherdak, V. I. (Physics Engineering Inst., Moscow). Fiz. Metal. Metalloved.; 34: No. 4, 856-858(1972). (In Russian).

Gamma resonance absorption spectra were investigated for ^{57}Fe in the compounds $ZrFe_2$ and $ZrFe_2H_{0.3}$. The Laves phase of $ZrFe_2$ has the $MgCu_2$-type of cubic lattice with 24 atoms in the elementary cell, and is ferromagnetic with a Curie temperature of approximately 630°K. Neutronographic studies of the hydride $ZrFe_2H_{0.3}$ showed that the hydrogen is localized in a tetrahedral position, with its nearest neighbors being three atoms of Fe and one atom of Zr. (KSW)

26683 X-RAY SPECTRA AND ELECTRONIC STRUCTURE OF METAL-LIKE COMPOUNDS OF NIOBIUM. Semnonov, S. A.; Kurmaev, E. Z.; Minin, V. I.; Shveikin, G. P. pp 14-16 of Voprosy Obshchei i Prikladnoi Fiziki. Genkin, Ya. E. (ed.). Moscow; Izdatel'stvo Nauka Kazakhskoi SSR (1972). (In Russian)

From 2nd republic conference on problems in general and applied physics; Alma-Ata, USSR (20 Oct 1969). See CONF-691072-.

The L x-ray spectra of Nb compounds with light elements were investigated: NbC_x, NbN, NbO, and the M_V bands of Nb in NbC_x were obtained. The genesis and structure of the electrical bands in these compounds are contrasted with x-ray data and band-structure calculations. Considerable similarity of the x-ray spectra of the different series in compounds of V and Nb is pointed out, given the same metalloids for comparison. (tr-auth)

26684 X-RAY STUDY OF THE ELECTRONIC STRUCTURE OF Zr–C ALLOYS. Korsunskii, M, I.; Genkin, Ya. E.; Lifshits, V. G. pp 16-20 of Voprosy Obshchei i Prikladnoi Fiziki. Genkin, Ya. E. (ed.). Moscow; Izdatel'stvo Nauka Kazakhskoi SSR (1972). (In Russian)

From 2nd republic conference on problems in general and applied physics; Alma-Ata, USSR (20 Oct 1969). See CONF-691072-.

The emission bands of Zr were studied in the series of alloys: ZrC_x, where x = 0.08, 0.3, 0.4, 0.58, 0.7, and 0.89. The $L\beta_2$ bands in these compounds were corrected for equipment distortions and final width of the L_{III} level. A double-humped $L\beta_2$ band structure was obtained, indicating the existence of two groups of electrons differing in energy in the outer electron band: collectivized electrons and electrons responsible for local bonds. The concentration of collectivized electrons was determined from the spectrum and was found to agree with the character of the conductivity. (tr-auth)

26685 X-RAY L SPECTRUM OF ZIRCONIUM AND ITS COMPOUNDS WITH NITROGEN AND OXYGEN. Litvinova, L. B.; Pastushuk, N. S. pp 20-24 of Voprosy Obshchei i Prikladnoi Fiziki. Genkin, Ya. E. (ed.). Moscow; Izdatel'stvo Nauka Kazakhskoi SSR (1972). (In Russian).

From 2nd republic conference on problems in general and applied physics; Alma-Ata, USSR (20 Oct 1969). See CONF-691072-.

X-ray spectra were obtained from samples of pure Zr, its nitride, and dioxide, and the two-phase α-Zr + ZrN. The wavelength and form of the lines were determined. Discussion of the experimental results is based on the stable configurations developed by the school of G. V. Samsonov. (tr-auth)

26686 ENTHALPY OF FORMATION OF SOME METALLOID COMPOUNDS OF Ti AND Zr AND THEIR CHEMICAL BOND CHARACTER. Morozova, M. P.; Gol'braikh, E. I.; Ariya, S. M. pp 24-27 of Voprosy Obshchei i Prikladnoi Fiziki. Genkin, Ya. E. (ed.). Moscow; Izdatel'stvo Nauka Kazakhskoi SSR (1972). (In Russian)

From 2nd republic conference on problems in general and applied physics; Alma-Ata, USSR (20 Oct 1969). See CONF-691072-.

A correlation between the break points on the straight-line formation enthalpy vs x was established in the systems TiO_x, TiN_x, and ZrN_x; and also between the number of d-symmetry electrons in metallic Ti and Zr as determined from x-ray emission spectra. The d-symmetry electrons of Ti and Zr diverge in the formation of metal–nonmetal bonds. (tr-auth)

26687 MEGAGAUSS PHYSICS. Fowler, C. M. (Los Alamos Scientific Lab., NM). Science; 180: No. 4083, 261-267(20 Apr 1973).

Fields greater than 10 MG can be produced by explosive flux compression and fields up to 3 MG with capacitor banks. Measurement of fields up to 10 MG is reliable, but difficulties may be expected at higher fields. Megagauss fields have been applied successfully as high-pressure sources, in high-energy particle physics, and in solid-state investigations. Other uses remain to be exploited: plasma compression by megagauss fields has been relatively unsuccessful but shows promise; their use as particle accelerators has been studied only theoretically; and much work remains to be done, both experimentally and theoretically, in connection with applications of megagauss fields in solid-state physics. (50 references) (auth)

26688 A CALCULATION OF MAGNETIC TRANSITION TEMPERATURES OF RARE-EARTH ALLOYS. Yang, Tien Tsai; Robinson, Lawrence Baylor (School of Engineering and Applied Science, University of California, Los Angeles, California 90024). J. Appl. Phys. 44: No. 2, 863-864 (Feb 1973).

A theoretical expression for magnetic transition temperatures of binary rare-earth alloys is proposed based on the similarity between the expressions of spin-disorder resistivity and transition temperatures of pure rare-earth metals. The proposed expression for the magnetic transition temperature for binary rare-earth alloys is kT_c (or T_p) = $(-3\pi Z^2)/E_F\Omega^2\ \Sigma_{Rn\neq 0}\Phi\ (2K_FR)\ [x(1-x)V_{ab}^2 + xG_a^2(g_a-1)^2j_a(j_a+1)+(1-x)G_b^2\ (g_b-1)^2j_b(j_b+1)]$, where $\Phi\ (2K_FR) = (K_FR\ \cos K_FR - \sin K_FR)/(K_FR)^4$ and the other symbols have their usual meaning. The above expression is obtained from considering an equation for spin disorder resistivity given by Dekker. The experimental data of magnetic transition temperatures of Gd–Dy system have been used to test the validity of the proposed equation. The agreement between theory and experiment is reasonably good. (auth)

26689 MAGNETIC PROPERTIES OF $RT_{3-x}Ni_x$ COMPOUNDS (R = Dy OR Ho AND T = Fe OR Co). Narasimhan, K. S. V. L.; Butera, R. A.; Craig, R. S. (Department of Chemistry, University of Pittsburgh, Pittsburgh, Pennsylvania 15213). J. Appl. Phys. 44: No. 2, 879-882 (Feb 1973).

The effect of varying electron concentration on the magnetic ordering in the ternary intermetallic compounds $DyCo_{3-x}Ni_x$, $DyFe_{3-x}Ni_x$, $HoCo_{3-x}Ni_x$, $HoFe_{3-x}Ni_x$, with $0 < x < 3$, has been investigated by saturation magnetization studies. The results show a filling of the Co and Fe bands and also a polarization of the 3d band of nickel. In the case of the Co compounds an additional contribution from the induced moment on cobalt by the rare-earth exchange field is found to be important. (auth)

Moessbauer Effects and NMR

Refer also to abstracts 26403 and 26682.

26690 THERMOMETRIC DETECTION OF NUCLEAR MAGNETIC RESONANCE. Trodahl, H. J.; Turrell, B. G. (Univ. of British Columbia, Vancouver). J. Low Temp. Phys.; 10: No. 1-2, 217-223(Jan 1973).

Nuclear magnetic resonance was detected in nonmagnetic materials by observing the temperature rise in the sample. The experiments were performed at temperatures between 1 and 4°K, and results are presented for the ^{27}Al resonance in aluminum metal and the ^{19}F resonance in a sample of doped CaF_2. The primary sources of noise were identified and ways of improving the apparatus are discussed. The technique could prove useful in experiments that require a large range of frequencies to be swept and in experiments investigating the effects of strong rf fields. (auth)

26691 TEMPERATURE DEPENDENCE OF RECOILLESS FRACTIONS IN TUNGSTEN. Ruth, R. D.; Hershkowitz, N. (Univ. of Iowa, Iowa City). Phys. Lett. A; 43A: No. 2, 203-204 (26 Feb 1973).

The recoilless fractions of ^{182}W, ^{184}W, and ^{186}W were simultaneously measured from 30 to 100°K in 10°K steps. They are found to agree with previous calculations of Raj and Puri. (auth)

26692 CHARGE COMPENSATION OF Fe^{3+} IONS IN V_2O_5 (ESR MEASUREMENTS). Jansen, K.; Sperlich, G. (Technische Hochschule, Darmstadt, Ger.). Phys. Status Solidi (b); 55: No. 2, 495-502(1 Feb 1973).

The ESR spectrum of iron-doped V_2O_5 single crystals shows two different line groups. Analysis of the angular dependence and intensity measurements prove that, contrary to Cr^{3+} ions, Fe^{3+} ions occupy lattice sites and tetrahedral sites as well. This is in agreement with published Moessbauer results. Moreover, the influence of the Fe^{3+} concentration upon the signal intensity of the vanadium $3d^1$ electron was investigated. (auth)

26693 EFFECT OF ESR TRANSITIONS ON ANOMALOUS MOESSBAUER SPECTRA. Srivastava, J. K. (Tata Inst. of Fundamental Research, Bombay). Phys. Status Solidi (b); 55: No. 2, K119-K124(1 Feb 1973).

It is shown that a combined Moessbauer/ESR experiment can distinguish between the superparamagnetic and the electronic relaxation effects. Thus, it can be determined whether the observed anomalous Moessbauer line shapes are due to either effect. (20 references.) (DLC)

26694 THEORETICAL STUDY OF THE ISOTROPIC KNIGHT SHIFT IN LANTHANUM. Gupta, A.; Kumar, S. (Saha Inst. of Nuclear Physics, Calcutta). pp 651-655 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Bombay, February 1-4, 1972. Bombay; Dept. of Atomic Energy (1972).

26695 HYPERFINE MAGNETIC FIELDS IN SOME 2:17 RARE-EARTH IRON COMPOUNDS USING THE MOESSBAUER EFFECT. Agarwal, V. K. (Roorkee Univ., India); Kuzmin, R. N. pp 657-660 of Proceedings of the Nuclear Physics and Solid State Physics Symposium, Bombay, February 1-4, 1972. Bombay; Dept. of Atomic Energy (1972).

26696 REDISTRIBUTION OF VANADIUM ATOMS IN IRON–NICKEL PERMALLOYS. Gruzin, P. L.; Rodionov, Yu. L.;

Mkrtchyan, V. S. (Inst. of Metal Science and Physics of Metals, Moscow). Fiz. Metal. Metalloved.; 34: No. 4, 878-879(1972). (In Russian).

The redistribution of V atoms in Fe–Ni alloys having a fcc lattice was investigated. The sensitivity of the method was raised by enriching the alloy Ni–15% Fe–13% V with the ^{57}Fe isotope up to 18%, since the experiments were conducted with a Moessbauer spectrometer. The results indicated that the velocity of redistribution of V atoms during low-temperature annealing (450 to 500°C) of deformed alloys was lower than in the case of quenched samples. (KSW)

Theory

Refer also to abstracts 26021 and 27176.

PHYSICS (THEORETICAL)

Refer also to abstract 25800.

26697 STATISTICAL MECHANICS. Pathria, R. K. Oxford; Pergamon Press (1972). 527p.

The subject is covered in chapters; statistical basis of thermodynamics; elements of ensemble theory (Liouville's theorem); the canonical ensemble (the partition function); the grand canonical ensemble; formulation of quantum statistics; the theory of simple gases; ideal Bose systems (black-body radiation, sound waves, excitations in liquid helium II); ideal Fermi systems (magnetic behavior, Pauli paramagnetism, Landau diamagnetism, de Haas-van Alphen effect, electron gas in metals, white dwarf stars, the atom); statistical mechanics of interacting systems—the method of cluster expansions, (virial expansion of the equation of state, cluster expansion for a quantum-mechanical system, the binary collision method of Lee and Yang), the method of pseudopotentials, (low-temperature behavior of an imperfect Fermi gas, low-temperature behavior of an imperfect Bose gas, states with quantized circulation, "rotation" of the superfluid), the method of quantized fields; (low-lying states of an imperfect Bose gas, low-lying states of an imperfect Fermi gas, Landau's phenomenological theory); theory of phase transitions (Mayer's theory of condensation, the theory of Yang and Lee, the lattice gas and the binary alloy, Ising model, one- two- and three-dimensional lattices, the critical indices, the law of corresponding states); fluctuations (spatial correlations in a fluid, Einstein–Smoluchowski theory of the Brownian motion, Langevin theory of Brownian motion, the Fokker–Planck equation, spectral analysis of fluctuations—the Wiener–Khintchine theorem, the fluctuation-dissipation theorem, the Onsager relations. The book contains a fairly extensive bibliography. Among the appendixes are: influence of boundary conditions on the distribution of quantum states; consideration of the Bose–Einstein integrals; consideration of the Fermi–Dirac integrals. (UK)

26698 MECHANICS. Second edition. Landau, L. D.; Lifshitz, E. M. Oxford; Pergamon Press (1969). 165p.

Translation of Mekhanika by J. B. Sykes and J. S. Bell.

The subject is dealt with in sections: the equations of motion (generalized co-ordinates, the principle of least action, Galileo's relativity principle, the Lagrangian for a free particle, the Lagrangian for a system of particles); conservation laws (energy, momentum, centre of mass, angular momentum, mechanical similarity); integration of the equations of motion (motion in one dimension, determination of the potential energy from the period of oscillation, the reduced mass, motion in a central field, Kepler's problem); collisions between particles (disintegration of particles, elastic collisions, scattering, Rutherford's formula, small-angle scattering); small oscillations (free oscillations in one dimension, forced oscillations, oscillations of systems with more than one degree of freedom, vibrations of molecules, damped oscillations, forced oscillations under friction, parametric resonance, anharmonic oscillations, resonance in nonlinear oscillations, motion in a rapidly oscillating field); motion of a rigid body (angular velocity, the inertia tensor, angular momentum of a rigid body, the equations of motion of a rigid body, Eulerian angles, Euler's equations, the asymmetrical top, rigid bodies in contact, motion in a noninertial frame of reference); the canonical equations (Hamilton's equations, the Routhian, Poisson brackets, the action as a function of the coordinates, Maupertuis' principle, canonical transformations, Liouville's theorem, the Hamilton–Jacobi equation, separation of the variables, adiabatic invariants, general properties of motion in s dimensions). (UK)

26699 NEW REPRESENTATION OF SUBDYNAMICS BY AN N-PROJECTORS METHOD. Demendy, Z. (Univ. Miskolc, Hungary). Physica; 63: No. 1, 33–47 (1 Jan 1973).

By means of N projectors a realization of the subdynamics for a system of N arbitrary subsystems is given. It is shown that the method in the case of a system of an infinite number of indistinguishable particles is equivalent with a class of solutions of the equations of the dynamical correlation-patterns representation. The basic formulas of the subdynamics are reformulated for the purpose of future applications. (auth)

26700 HARMONIC OSCILLATOR PHASE, THERMAL EQUILIBRIUM, AND O(2,1). Huang, H. W. Columbia, SC; Univ. of South Carolina (1972). 46p. University Microfilms Order No. 73-3602.

Thesis (Ph. D.).

Quantum states of the harmonic oscillator are discussed which have the following physical properties: They define states of maximum phase resolution; they can be parameterized by the temperature T and a phase parameter ϕ so that the state of thermal equilibrium can be obtained by uniform averaging of these states over ϕ. The problem of finding the Hamiltonian interactions which generate these states (a process that could be closely related to the approach to thermal equilibrium) is formulated and solved generally. Transformation properties induced on the states by these Hamiltonians are discussed. In particular, a class of them display the interesting character that they transform arbitrary initial states into a fixed final state. Finally, as a by-product of our formalism, we have re-established some of the well known results of O(2,1). (Diss. Abstr. Int., B)

REACTOR TECHNOLOGY

26701 UKAEA ADVANCED REACTORS. Fifth edition. London; United Kingdom Atomic Energy Authority (1972). 123p.

Information is presented on United Kingdom reactors, under the headings: UKAEA research reactors; UKAEA advanced reactors (DFR, WAGR, SGHWR, PFR); Dragon; Magnox reactors; AGR power reactors; university research reactors (Consort-2 reactor); Magnox reactors overseas; other British reactors overseas; summary of design data for Magnox reactors in the UK, and for AGR power stations under construction in the UK. An historical and descriptive account is given of each reactor. (UK)

Power Reactor Development

Refer also to abstracts 26415 and 27115.

26702 (ANL-RDP-13) REACTOR DEVELOPMENT PROGRAM PROGRESS REPORT, JANUARY 1973. (Argonne National Lab., ILL). 28 Feb 1973. Contract W-31-109-eng-38. 155p. AT $7.60.

Highlights of project activities for January 1973 are summarized. The EBR-II operations and systems engineering are reported. Heat transfer and fluid flow studies for LMFBR design support are reviewed. The development of EBR-II and FFTF instrumentation is summarized. Monitoring and sampling methods and devices are examined for liquid sodium systems. Studies of LMFBR fuels and materials, fuel cycles, physics, and safety are described. (DCC)

26703 (CEA-CONF-2100) DEVELOPMENT OF HIGH-TEMPERATURE REACTORS IN FRANCE. Pelce, J.; Brisbois, J.; Delpeyroux, P.; Patarin, L.; Audinet, M.; Baschwitz, R.; Martin, G. (Commissariat a l'Energie Atomique, Paris (France); Groupement Industriel Francais pour les Reacteurs a Haute Temperature, Paris). 1972. 26p. (In French). (CONF-721062-1). Dep. NTIS (U. S. Sales Only).

From NUCLEX 1972: 3rd international fair of nuclear industries and technical meetings; Basel, Switzerland (16 Oct 1972).

During the last 3 years France has been actively engaged in work on high-temperature reactors. This activity is carried out both by the Commissariat à l'Energie Atomique, and French industry. In the field of fuel, the CEA and French industry, have developed, in their research laboratories and workshop, the techniques and the means to manufacture and test different types of fuel elements. Many irradiations in experimental CEA reactors are in progress or completed and will provide the information needed to predict the behavior of the fuel element and its components. Parallel studies are being carried out at the CEA to intercompare the different fuel elements and fuel cycles from the viewpoint of yields and cost of the cycle. Where the nuclear boiler components are concerned, experience gained in the field of gas-cooled reactors gives France the competence and test means necessary to solve certain problems without difficulty. Work is devoted mainly to research on components specific to HTR's, such as heat insulation and high-power coolant loops. (auth)

26704 (HEDL-TME-72-145) DEVELOPMENT FACILITIES. (Hanford Engineering Development Lab., Richland, Wash.). 1972. 173p. AT $5.45.

The various development facilities available at HEDL for use in the FFTF/LMFBR Program are described. The facilities described encompass: The Fast Flux Test Facility (FFTF) Reactor Plant as a test bed; the High Temperature Sodium Facility (HTSF), a non-radioactive large component test facility; general sodium facilities; hydraulics laboratory; fuel fabrication facilities, fuel examination facilities, chemical and microstructural analysis laboratories, and supporting laboratory capabilities. Facilities utilization is based on priorities of the various programs with the FFTF having the highest priority. The facilities are capable of modification to suit the specific test requirements. Sufficient detail is provided to permit assessment of use for participants in the LMFBR Program. Additional details may be obtained from the Hanford Engineering Development Laboratory. (auth)

26705 (KFK-1272/3) FAST BREEDER PROJECT. Third quarterly report, 1972. (Kernforschungszentrum, Karlsruhe (West Germany)). Nov 1972. 190p. (In German). (EUR-4849). Dep. NTIS (U.S. Sales Only) $11.50.

Work performed by the Karlsruhe Nuclear Research Center within the Fast Breeder Project in the 3rd quarter of 1972 is reported. Some of the most important results in the following fields are presented: fuel pin development; material studies; corrosion in sodium flow and coolant analyses; physics; welding technology; and safety and instrumentation. (LCL)

26706 (ORNL-4756) COMPUTATIONAL METHODS IN NUCLEAR REACTOR STRUCTURAL DESIGN FOR HIGH-TEMPERATURE APPLICATIONS: AN INTERPRETIVE REPORT. Gallagher, R. H. (Oak Ridge National Lab., TENN). Feb 1973. Contract W-7405-eng-26. 89p. Dep. NTIS.

The status of the finite-element method as a basis for design analyses of nuclear reactor structures for elevated-temperature service is reviewed and assessed. First, a general picture is given of procedures in analyses of the complete structural system from the view of the finite-element method, and then reviews are presented of two classes of elements important to nuclear reactor structures—solid elements and thin-shell elements. Questions of inelastic analysis are discussed in chapters dealing with time-independent plasticity and time-dependent viscoelasticity and creep respectively. Since the accuracy of design analysis for elevated-temperature conditions is dependent upon the analysis of heat transfer, the utilization of the finite-element method in this connection is also surveyed. Finally, an examination is made of the role of the finite-element method in the relevant, but more peripheral topics of dynamic, finite displacement (stability), and fracture mechanics analyses. An assessment of the scope and limitations of finite-element analysis for the intended applications is made. (auth)

26707 (UCRL-74517) COMPARISON OF ETRAN CALCULATIONS WITH EXPERIMENTS. Kovar, F. R. (California Univ., Livermore. Lawrence Livermore Lab.). 12 Feb 1973. 18p. (CONF-730204-2). Dep. NTIS.

From Symposium on IEMP; San Diego, California, USA (6 Feb 1973).

A modified version of the electron–photon transport code, ETRAN, was used to calculate charge and voltage generation, caused by IEMP effects. Calculations on forward and backward surface emission have been compared to three independent, incident x-ray experiments and to data from literature on electron back scattering from thick targets. The results of these comparisons indicate agreement to ±30% for incident photon energies in the 10- to 100-keV region and agreement to ±35% for incident electron energies from 10 keV to 10 MeV. (auth)

26708 (WARD-3045-T-2-B-7) CORE RESTRAINT DEVELOPMENT QUARTERLY PROGRESS REPORT FOR PERIOD ENDING NOVEMBER 30, 1972. French, J. W. (Westinghouse Electric Corp., Madison, PA. Advanced Reactors Div.). Jan 1973. Contract AT(11-1)-3045. 25p. AT $4.00.

In a program to develop an LMFBR core restraint system, core restraint analytical requirements were developed and incorporated in the program. The results of the friction materials screening survey were compiled. "The Comparative Study of Three Core Restraint Systems Considering Uncertainties in Irradiated Material Properties" was issued. The testing structure including the upper and lower core plates was erected. The test rig is capable of modeling the axial and radial core support and restraint systems of various LMFBR designs. The lateral-lead system design is complete. A static bending analysis of the simulated fuel assembly was performed to determine the effect on deflection resulting from attaching the contact pad to a 3.25 in. OD spine. Testing methods for attaching the contact pads to the core assembly spines were initiated. (FS)

26709 FAST REACTOR DEVELOPMENT IN GERMANY. Wirtz, K. (Karlsruhe Nuclear Research Center, Ger.). Proc. Amer. Power Conf.; 34: 71-82(1972).

From 34th annual meeting of the American power conference; Chicago, Illinois, USA (18 Apr 1972).

See CONF-720465-.

26710 FAST BREEDER REACTOR DEVELOPMENT IN THE USSR. Taylor, J. J. (Westinghouse Electric Corp., Pittsburgh). Proc. Amer. Power Conf.; 34: 98-109(1972).

From 34th annual meeting of the American power conference; Chicago, Illinois, USA (18 Apr 1972).

See CONF-720465-.

Physics and Core Engineering

Refer also to abstract 27084.

26711 (AI-AEC-13049) LMFBR PHYSICS PROGRAMS. (Quarterly Technical Progress Report, October–December 1972.

Alter, H.; Rose, P. F.; Hubner, R. S.; Otter, J. M.; Alston, T. (Atomics International, Canoga Park, Calif.). 22 Feb 1973. Contract AT(04-3)-824. 22p. Dep. NTIS $3.00.

Progress on the development of ENDF/B data files and analysis of benchmark assemblies and on Monte Carlo analyses of past reactor design is reported. (JWR)

26712 (ANL-7937) EBR-II MATERIALS-SURVEILLANCE PROGRAM. III. Results of SURV-3. Greenberg, S.; Strain, R. V.; Ebersole, E. R. (Argonne National Lab., Ill.). Sep 1972. Contract W-31-109-Eng-38. 28p. Dep. NTIS $4.00.

The third subassembly (SURV-3) of the EBR-II materials-surveillance program has been removed and subjected to examination after 2186 days in the reactor core and an estimated average fluence of 3.6×10^{20} n/cm^2 at energy levels greater than 0.82 MeV (6.6×10^{21} n/cm^2 at levels greater than 0.11 MeV; 1.2×10^{22} n/cm^2 total). Stellite 6B, stainless steel Types 416 and 420, 17-4 PH stainless steel, and T-1 tool steel exhibited deterioration in mechanical properties, which may indicate potential problems in some reactor components. (Components of these materials, however, are in low-flux zones of the reactor and are replaceable.) Of the materials exposed, only Berylco-25 and tantalum exhibited significant corrosion, which indicates they are unsuitable for use in contact with sodium under the conditions of this test. Type 304 stainless steel (the basic material of construction of EBR-II) and canned graphite shield structures continue to perform satisfactorily. Tantalum and aluminum bronze (Ampco 18) experienced density decreases equivalent to a maximum swelling of 0.8 and 0.4%, respectively. (auth)

26713 (CONF-721104-7) MATERIALS AND DESIGN CONCEPTS OF GAS COOLED REACTOR SYSTEMS. Paper Number 14. Landis, J. W.; Watson, J. F. (Gulf General Atomic Co., San Diego, Calif.). [nd]. 46p.

From INCO Power Conference; Kyoto, Japan (28 Nov 1972).

26714 (DP-Report-617) TEMPERATURE COEFFICIENTS AND STABILITY INVESTIGATION OF A H.T.R. SURVEY. Dragon Project. Journet, J.; Woloch, F. (Atomic Energy Establishment, Winfrith (England)). Mar 1969. 42p. Dep. NTIS (U. S. Sales Only) $4.25.

Results of calculations for temperature coefficients and stability of high temperature gas cooled reactors operating near the cost optimum are presented. (JWR)

26715 (EURFNR-1041) DETERMINATION OF γ HEATING IN THE STRUCTURAL MATERIALS OF FAST CRITICAL ASSEMBLIES BY RADIOPHOTOLUMINESCENCE GLASSES. Doerfel, H. R. (Kernforschungszentrum, Karlsruhe (West Germany). Institut Fuer Neutronenphysik und Reaktortechnik). Jun 1972. 65p. (KFK-1624). Dep. NTIS.

Work performed under United States–Euratom fast reactor exchange program.

Radiophotoluminescence glasses were used for the determination of the γ-heating in the structural materials of fast reactors. For this application an investigation of the absorption behavior of the glasses in mixed radiation fields was necessary. It was shown, that with regard to the γ-absorption the glasses are very similar to steel. So the γ-effect in the glass is nearly proportional to the γ-heating in steel. The neutron effect, amounting up to 50% of the total effect in reactors, can be corrected by means of fission rates. Measurements were performed in different fast critical assemblies. The results were in good agreement with calculations and ionization chamber measurements. (auth)

26716 (GEAP-10221-12) DEFICIENT COOLING. 12th QUARTERLY PROGRESS REPORT, APRIL 1–JUNE 30, 1972. (General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.). Jul 1972. Contract AT(04-3)-189. 127p. Dep. NTIS.

Steady-state critical heat flux (CHF) data at 800 and 1000 psi for various mass fluxes were taken in a 16-rod assembly, with a 12-foot-long axial cosine variation. Excellent correlation of the data was obtained and no serious reductions of critical power were experienced for a bowed corner rod or a reduced corner clearance of 0.060 inch between spacers on 19½-inch centers. Transient data were also obtained for five typical reactor transients. No unexpected CHF was noted for operating transients at representative power levels. In most cases power levels were increased above normal reactor operating values to find the CHF thresholds. CHF and heat transfer data were obtained for a bulged heater simulating a swollen fuel rod. Incident CHF was identical to that in the same assembly with a uniform heater. (auth)

26717 (INIS-mf-74) MAXIMIZING OF THE MEAN FUEL ELEMENT BURN-UP IN A NATURAL URANIUM REACTOR. Bartosek, V. 9p. (In Slovak). (CONF-701214-1). INIS.

From 5th conference on nuclear power; Piestany, Czechoslovakia (1 Dec 1970).

The problem is formulated of maximizing the mean fuel burnup in a natural-uranium reactor. For a homogeneous plate model, the solution is expressed analytically by use of the Pontryagin principle. The space distribution of local burnup and the corresponding distribution of thermal flux are shown. With the maximizing distribution the mean burnup is 5 to 10% in excess of that with constant distribution. (INIS)

26718 (JAERI-M-4825) FURNACEJ, A TWO-DIMENSIONAL DIFFUSION THEORY BURNUP CODE. Ikawa, K. (Japan Atomic Energy Research Inst., Tokyo). May 1972. 80p. NTIS (U. S. Sales Only).

FURNACEJ is a two-dimensional (R-Z) diffusion code for use in fast reactor criticality and burnup analyses. It is an extension of FURNACE which is designed to use ABBN set in 26 groups as a microscopic cross section library. FURNACEJ can use three different cross section sets, i.e., JAERI-FAST set, ABBN set and RCBN set, in 25 groups. The programming is in FORTRAN-IV. It requires a 77k core memory and one peripheral storage unit for a microscopic cross section library. Running time for a k_{eff} calculation on a CDC 6600 is about 50 seconds for a problem of 23×29 meshes, 2 groups and 7 regions. Each successive burnup time step requires about 40 seconds. (auth)

26719 (JAERI-M-4826) STUDY OF GROUP CONSTANTS FOR DESIGN CALCULATIONS OF FAST REACTORS. Tone, T. (Japan Atomic Energy Research Inst., Tokyo). Jun 1972. 197p. NTIS (U. S. Sales Only).

Group constants for design calculations of fast reactors have been studied. All the reactor models considered are large sodium-cooled fast reactors consisting of core and blanket. In most cases, PuO_2 is chosen for core fuel and $^{238}UO_2$ for blanket fuel. PuC and $^{235}UO_2$ core fuels are also used for a comparison with PuO_2-fueled reactors. The group constants in the study are defined as averaged values of nuclear cross sections weighted over energy groups by the fundamental mode spectrum of the diffusion equation. For the typical standard group-constant sets, YOM, HR and ABBN, the 1/E spectrum, the fission spectrum, the spectrum derived from the assumption of constant collision density etc. are used as the weighting spectrum of nuclear data. Paying attention to the composition- and temperature-dependence of group constants, the accuracy of the group constants calculated by these approximate weighting spectra has been examined in detail by comparing with the group constants calculated by exact fundamental mode spectra. Differences in nuclear characteristics calculated by using the group constants obtained by different weighting spectra have been investigated. The nuclear characteristics calculated are the effective multiplication factor, the sodium void effect, the Doppler effect, the breeding ratio and kinetics parameters. Special attention has been paid to the effect of elastic removal cross sections on the sodium void effect. (auth)

26720 (NP-19666) RESEARCH AND DEVELOPMENT WORK, 1971. Scientific Results Report. (Kernforschungsanlage, Juelich (West Germany)). 1971. 312p. (In German). Dep. NTIS (U. S. Sales Only).

Progress reports are given for the projects HTR with helium turbine, fuel reprocessing, nuclear process heat, incore-thermionic reactor, and magnetohydrodynamic energy conversion. Also reported are the research and development programs for each subdivision of the Juelich nuclear center. The number of programs are: reactor materials, 9; reactor development, 12; reactor components, 7; nuclear physics, 7; neutron physics, 3; plasma physics, 8; solid state physics, 7; technical physics, 8; physical chemistry, 8; radiochemistry, 3; analytical chemistry, 9; chemical technology, 6; medicine, 5; botany, 9; neurobiology, 3; radioagriculture, 2; research reactors, 4; radiation protection, 2; electronics, 4; reactor experiments, 5; applied mathematics, 6; decontamination, 1; scientific technology, 2. (HBG)

26721 (RT/FI-(72)45) ASSESSMENT OF THE RELIABILITY OF THE CNEN'S METHODS FOR THE NEUTRONIC DESIGN OF PWR'S. Part I. Analysis of the "Belgian Recycling Programme" Experiments. Orestano, F.; Pistella, F. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 13 Nov 1972. 65p. Dep. NTIS (U. S. Sales Only) $5.25.

CNEN neutronic design codes for the calculation of core configurations in present generation PWR's are described. In addition tests are presented which have been performed to show the validity of CNEN codes for the calculation of PWR cores with particular stress on plutonium recycling. A comparison is reported between values calculated at CNEN and the experimental values obtained in the VENUS critical facility at Mol by CEN/SCK. (auth)

26722 (WARD-3045-T-2-C-5) PRELIMINARY LMFBR CORE STRUCTURAL DESIGN CRITERIA. Garkisch, H. D. (Westinghouse Electric Corp., Madison, Pa. Advanced Reactors Div.). Feb 1973. Contract AT(11-1)-3045. 116p. AT $5.45.

Guidelines are presented for structural analysis and design of Liquid Metal Fast Breeder Reactor (LMFBR) core components except fuel rod cladding. These design criteria are applicable to temperature and loading conditions where creep effects are significant and where the design and analysis must guard against time-dependent failure modes. They are also applicable to service conditions where neutron fluence produces significant changes in material properties. Therefore, the methods of analysis and design limits must reflect the dependence of material behavior on both time and irradiation. Since the available high-temperature, irradiated property data are limited, the requirements listed are preliminary and must be revised as new data become available. 5 references. (auth)

26723 (WARD-3045-T-4-B-5) ANALYSIS OF ZPPR-2 MEASUREMENTS. Topical Report. Paik, N. C.; Pitterle, T. A. (Westinghouse Electric Corp., Madison, Pa. Advanced Reactors Div.). Feb 1973. Contract AT(11-1)-3045. 67p. AT $5.45.

Analyses of measurements for the plate assembly in the ZPPR-2 critical assembly are described. Preliminary results for the reactivity effect of rod substitution in the central region of ZPPR-2 are also given. The critical assembly is a large, two-enrichment zone assembly; simulates an LMFBR demonstration reactor in size and composition, without control rods; and represents the best, currently available assembly for testing of LMFBR demonstration plant nuclear design methods and data. (auth)

26724 (WARD-3045-T-4-B-6) EFFECT OF DIFFERENT NEUTRON CROSS SECTION LIBRARIES ON THE PREDICTION OF THE BREEDING RATIO IN AN LMFBR. Doncals, R. A.; Rittenberger, R. V.; Robinson, H. Jan 1973. Contract AT(11-1)-3045. 35p. AT $4.00.

The sensitivity of the breeding ratio of the LMFBR Demonstration Plant to the modified ENDF/B Version II and ABBN cross section libraries was evaluated by performing consistent R-Z, 2DB calculations for the Demonstration Plant. The results of this analysis indicated that the ENDF/B breeding ratio is lower than the ABBN value by approximately 5.2%. The individual breeding ratios in the core, radial blanket, and axial blanket are lower by approximately 6, 4, and 6%, respectively. (auth)

26725 (WARD-3045-T-4-B-7) STUDIES OF APPLICATIONS OF CROSS SECTION DATA AND CRITICAL EXPERIMENT DATA TO REACTOR DESIGN QUARTERLY PROGRESS REPORT FOR PERIOD ENDING JANUARY 31, 1973. Paik, N. C.; Durston, C. (Westinghouse Electric Corp., Madison, Pa. Advanced Reactors Div.). Feb 1973. Contract AT(11-1)3045. 13p. AT $4.00.

Research progress for the quarterly period ending January 31, 1973 is reported. The research covers nuclear data evaluation, evaluation of design methods, and cross section processing code development.

Control Elements, Systems, and Instrumentation

Refer also to abstracts 24646 and 24786.

26726 (BMBW-FBK-72-25) DETECTOR DRIVE SYSTEM. Stimler, M. (Allgemeine Elektricitaets-Gesellschaft, AEG-Telefunken, Frankfurt am Main (West Germany)). Dec 1972. 15p. (In German). Dep. NTIS (U.S. Sales Only).

The development program for a detector drive system is described. This drive shall bring the source range detectors and intermediate range detectors for the measurement of neutron-flux in boiling water reactors in a fixed position in the core before starting up. After the reactor has reached the power range the drive has to bring the detectors out of the core again. The manufactured prototype drive system, the control system and the long-time test of both systems are described. The results of the test and the experiences for the drive unit serial type are included. (auth)

26727 (GEAP-13824-3) LMFBR ALTERNATE SHUTDOWN SYSTEM DEVELOPMENT AND TESTING. Third Quarterly Report, July–September 1972. (General Electric Co., Sunnyvale, Calif. Breeder Reactor Dept.). Oct 1972. Contract AT(04-3)-189. 89p. Dep. NTIS.

The LMFBR alternate shutdown system criteria document was revised, and among several additions and clarifications, it includes a fuel damage definition based on fuel cladding ultimate burst stress at end of life and on weight percent fuel melt. This provides a method of determining system speed-of-response requirements. Several accident cases are analyzed by the method proposed in the criteria. Two prime candidate alternate shutdown system actuator concepts are presented, showing their technical feasibility. Other remaining concepts from the screening process are evaluated. Goals, recommendations, and concepts are presented for the logic system design. (auth)

26728 (GEAP-13825-2) LMFBR IN-CORE INSTRUMENTATION AND IN-VESSEL SURVEILLANCE SYSTEMS. Second Quarterly Report, April–June 1972. (General Electric Co., Sunnyvale, Calif. Breeder Reactor Dept). Jul 1972. Contract AT(04-3)-189. 58p. Dep. NTIS. AT $5.45.

Progress is reported in the development of in-vessel neutron detector and cable assemblies, acoustic systems for surveillance of core and in-vessel components, a subcriticality monitoring system, and an on-line reactivity computer. (HDR)

26729 (GEAP-13825-3) LMFBR IN-CORE INSTRUMENTATION AND IN-VESSEL SURVEILLANCE SYSTEMS. Third Quarterly Report, July–September 1972. (General Electric Co., Sunnyvale, Calif. Breeder Reactor Dept). Oct 1972. Contract AT(04-3)-189. 37p. Dep. NTIS $4.00.

Progress is reported in the development of in-vessel neutron detectors and cable assemblies and in the development of acoustic systems for surveillance of core and in-vessel components. (HDR)

26730 (HEDL-SA-418) BREAKDOWN PULSE NOISE IN REACTOR INSTRUMENTATION CABLE SYSTEMS. Philipp, L. D.; Schemmel, R. R.; Stringer, J. L. (Hanford Engineering Development Lab., Richland, Wash.). 8 Nov 1972. Contract AT(45-1)-2170. 28p. (CONF-721202-14). Dep. NTIS.

From Nuclear science symposium; Miami Beach, Florida, USA (6 Dec 1972).

Methods used to study cables for use at temperature and voltage within a nuclear environment are discussed and some results are presented. The materials studied in the testing program are Al_2O_3, SiO_2, and MgO. In general, cables are manufactured from any of the three materials, while end seals and connectors are fabricated from alumina or PYROCERAM*. Two similar experimental systems are presented. The first is the system used to measure BPN on cables and end seal. The second is the system used to study fabricated samples of typical cable and end seal insulation. Both systems have particular advantages and both are considered necessary for a comprehensive cable and material test program. 9 references. (auth)

26731 (INIS-mf-90) FUEL ELEMENT DEFECTS DURING REACTOR OPERATION AND THEIR DETECTION IN VARIOUS REACTOR TYPES. Melichar, M.; Hladky, F. 10p. (CONF-701214-7). INIS.

From 5th conference on nuclear power; Piestany, Czechoslovakia (1 Dec 1970).

An outline is given of the requirements on failed element detection systems in power reactors, and descriptions of such systems are given for gas-cooled and water-cooled thermal reactors and fast reactors. The detection system in the A-1 power station is based on mechanical collection of product isotopes of Rb and Cs, followed by measurement of their gamma activity with NaI(Tl) scintillation detectors. (INIS)

26732 (ORNL-TM-3716) SUBCRITICALITY MONITORING SYSTEM EVALUATION IN SEFOR. Buhl, A. R.; Ackermann, N. J. Jr.; Kryter, R. C.; Robinson, J. C. (Oak Ridge National Lab., Tenn.). Feb 1973. Contract W-7405-eng-26. 71p. Dep. NTIS $5.45.

A prototype of the ORNL subcriticality monitoring system (SMS) was successfully demonstrated on-line in the Southwestern Experimental Fast Oxide Reactor. A realistic engineering test and evaluation of the SMS was conducted to determine its performance in a hostile LMFBR-like environment (10^6 R/hr gamma, 350°F, liquid sodium coolant, and high electromagnetic noise background). Measurements were made over the full subcriticality range from critical to full shutdown for both Core I and Core II. Core I was a soft-spectrum core containing a large BeO inventory. Core II was achieved by replacing the BeO with steel, giving rise to a harder neutron spectrum. Secondary objectives achieved were (1) precise and accurate measurements of Λ/β for both cores, and (2) a limited intercomparison of reactivity values as determined by inverse kinetics rod drop and breakfrequency noise analysis methods. (auth)

26733 (RD/B/N-2318) ACCURACY OF PREDICTIONS OF ABSORBER WORTHS IN AGR LATTICES. Ballard, P. J.; Bridge, M. J.; Hart, A.; McDonald, D. A. N. (Central Electricity Generating Board, Berkeley (England). Berkeley Nuclear Labs.). Nov 1972. 34p. (RPC/RPNK/P-(72)2). Dep. NTIS (U.S. Sales Only).

Published work is reviewed on the control rod measurements in AGR lattices obtained from the HERO reactor and also from the critical facility at Berkeley Nuclear Laboratories. Unpub-

lished data on the re-analysis of some earlier HERO measurements are presented. Errors which would be associated with the use of design type methods in calculating CAGR rod worths are discussed. It is concluded that the application of laboratory results to civil AGR stations is difficult particularly as systematic discrepancies have been identified. (auth)

26734 SYSTEM FOR THE QUICK SHUTDOWN OF A WATER-COOLED NUCLEAR REACTOR. Belgian Patent 2,004,255. 21 Nov 1969. Priority date 19 Mar 1968, Federal Republic of Germany (F.R. Germany). 9p. (In French).

An auxiliary shutdown system is described. This system increases the reliability of the reactor shutdown system, in case of an accident, by hydraulically releasing the control rods into the reactor core. All controls are connected to pressure reservoirs partially filled with hydraulic fluid and covered by a cushion of pressurized air. The reservoirs feed directly to two evacuation pipes through fast closing valves. (FS)

26735 CONTROL ROD DRIVE INSIDE A PRESSURE VESSEL. Mattern, J.; Daublebsky, P. (to Licentia-Patent Verwaltungs-GmbH). German Patent 2,039,845. 24 Feb 1972. 11p. (In German).

A description is given of the operation system for a hydraulic or pneumatic control rod drive in which the pressure medium of the reactor pressure vessel is used as the driving force. The control rods are moved by a piston in a lifting cylinder which is directly connected to the pressure medium in the reactor pressure vessel. The lifting cylinder is connected on the other side by a conductor to equipment producing a counter pressure outside the reactor pressure vessel. This can be the primary water purification pump and/or the bearing pressure water pump of the reactor. (GF)

Containment Systems, Shielding, Waste Processing, and Radiation Protection

26736 (ANL-7987) EVALUATION OF COOLANT IMPACT EFFECTS ON THE REACTOR COVER. (A Parameter Study of the Plug-Jump Problem for the Fast-Reactor Containment Program). Marchertas, A. H.; Chang, Y. W.; Fistedis, S. H. (Argonne National Lab., Ill.). Nov 1972. Contract W-31-109-eng-38. 33p. Dep. NTIS $4.00.

Plug-jump, one of the safety problems in sodium-cooled fast-reactor design is analyzed. The effect of relevant parameter variations is shown on the partition of energy between the reactor cover and the vessel. Approximations of the energy supplied to the reactor cover, resulting from coolant impact, are discussed. Conclusions are drawn from the plug-jump study that are important to the designer concerned with safety of sodium-cooled fast reactors. (auth)

26737 (CEA-CONF-2164) ROLE OF ASSURED SAFETY THROUGH CAN RUPTURE DETECTION INSTALLATIONS. Graftieaux, J.; Vasnier, F. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). 1973. 12p. (In French). (CONF-730108-3). Dep. NTIS (U. S. Sales Only).

From Symposium on Nuclear Power Plant Control and Instrumentation; Prague, Czechoslovakia (22 Jan 1973).

The majority of reactors are equipped with a can rupture detection installation whose role is to detect can ruptures as soon as possible, to localize them, and to follow their evolution up to the discharge of the defective fuel element. For gas reactors, experiments have shown that the measurement of the concentration of fission gas is the best method. The aerolic independence of the blast loops makes it possible to improve the detection threshold and to obtain prelocalization data. A continuous measurement detector assures an incident detection of less than 20 seconds during handling of the fuels. The design of the equipment of Chinon, St. Laurent, and Bugey is described. For water reactors, the detection of delayed neutrons is well adapted to monitoring; it permits continuous measurements with short response time. Three installations are examined. For sodium reactors, three methods of general detection have been studied at Rapsodie. The detection of delayed neutrons is shown particularly well suited because of its selectivity and rapidity. (tr-auth)

26738 (GEAP-13822-2) LMFBR SHIELDING DESIGN EXPERIMENTS AND METHODS EVALUATION. Second Quarterly Progress Report, April–June 1972. (General Electric Co., Sunnyvale, Calif. Breeder Reactor Dept.). Jul 1972. Contract AT(04-3)-189. 79p. Dep. NTIS.

Both experimental and analytical work on LMFBR axial and radial shields is being conducted, with the experimental part being performed at the ORNL Tower Shielding Facility. Activities and technical progress for the period April through June 1972 are reported. The major topics include program definition and scheduling, test assembly design and fabrication, analytical studies, and quality assurance. (auth)

26739 (GEAP-13822-3) LMFBR SHIELDING DESIGN EXPERIMENTS AND METHODS EVALUATION. Third Quarterly Progress Report, July–September 1972. (General Electric Co., Sunnyvale, Calif. Breeder Reactor Dept.). Oct 1972. Contract AT(04-3)-189. 53p. Dep. NTIS.

Both experimental and analytical work on LMFBR axial and radial shields is being conducted with the experimental part being performed at the Oak Ridge National Laboratory (ORNL) Tower Shielding Facility. Activities and technical progress for the period July through September 1972 are reported. The major topics include program definition and scheduling, experimental measurements, analytical studies, and comparisons between experimental and calculated data. (auth)

26740 (HEDL-TME-73-16) HIGH STRAIN RATE TENSILE PROPERTIES OF PROTOTYPIC FTR VESSEL TYPE 308 WELD METAL (RM-32). Stichen, J. M. (Hanford Engineering Development Lab., Richland, WASH). Jan 1973. Contract AT(45-1)-2170. 39p. AT $4.00.

In the Fast Flux Test Facility (FFTF) and initial LMFBR's austenitic stainless steels and their weldments will be used as the main structural materials. As part of the safety analyses for these reactors, incidents or accidents are hypothesized and the response of the reactor structures to the forces associated with these occurrences are determined. The mechanical properties of the structural materials and their weldments at various strain rates and temperatures are needed to make these analyses. Results of elevated temperature high strain rate tests on prototypic FFTF vessel Type 308 weld metal are presented. Included are results on as-welded, thermally aged, and neutron irradiated weld metal. (auth)

26741 (WCAP-7706) AN EVALUATION OF SOLID STATE LOGIC REACTOR PROTECTION IN ANTICIPATED OPERATIONAL TRANSIENTS. Gangloff, W. C.; Loftus, W. D. (Westinghouse Electric Corp., Pittsburgh, Pa.). Jul 1971. 111p.

The reactor protection system is designed to sense abnormal plant conditions and to initiate action necessary to assure that acceptable fuel design limits are not exceeded for anticipated operational occurrences. The system is designed to have a very high probability of performing this safety function in any anticipated occurrence. A reliability analysis is presented which documents the measures taken in the design of the protection system utilizing solid state logic to assure high reliability of the protection function. Both random component failures and common-mode failures are discussed in detail. The results of the study show that the probability of protection system failure in anticipated transients is sufficiently low that no provision need be made in plant design to accommodate such hypothetical failure. 12 references. (auth)

26742 HIGHLY ABRASION-PROOF COATING MATERIAL FOR THE REACTOR LID ZONE OF A NUCLEAR POWER PLANT. Radcliffe, J. Q. Defazet-Aktuell; 26: No. 4, 207-209(1972). (In German).

An investigation has been made on a series of epoxide resin based coating materials suitable for the surface coating of reactor lids, and which has been especially developed for Magnox reactors. The wearing properties of concrete plate lids with and without coating have been tested and compared using an abrasion testing apparatus. (GF)

26743 PWR PLANT LIMITED-RELEASE RADWASTE SYSTEM DESIGN. Lagache, M. P.; Blatchford, J. D. (Bechtel Corp., San Francisco). Proc. Amer. Power Conf.; 34: 130-136(1972).

From 34th annual meeting of the American Power Conference; Chicago, Illinois, USA. (18 Apr 1972).

See CONF-720465–.

26744 DEVELOPMENTS IN NUCLEAR PLANT EFFLUENT MANAGEMENT SYSTEMS. Smith, J. M.; Kjemtrup, J. S. E. (General Electric Co., San Jose, CA). Proc. Amer. Power Conf.; 34: 137-147(1972).

From 34th annual meeting of the American Power conference; Chicago, Illinois, USA (18 Apr 1972).

See CONF-720465–.

26745 SYSTEM FOR SOLIDIFICATION AND PACKAGING OF RADIOACTIVE WASTE AT A PWR. Tuite, P. T. (Hittman Nuclear and Development Corp., Columbia, MD); Zimmerman, S S. R.; Boldt, G. K. Proc. Amer. Power Conf.; 34: 148-154(1972).

From 34th annual meeting of the American Power conference; Chicago, Illinois, USA (18 Apr 1972).
See CONF-720465-.

26746 RADIOACTIVE WASTE MANAGEMENT SYSTEM FOR HIGH-TEMPERATURE GAS-COOLED REACTORS. Gitterman, M.; Goodjohn, A. J. (Gulf General Atomic Co., San Diego, CA). Proc. Amer. Power Conf.; 34: 155-162(1972).
From 34th annual meeting of the American Power conference; Chicago, Illinois, USA (18 Apr 1972).
See CONF-720465-.

26747 USE OF REVERSE OSMOSIS FOR REMOVAL OF DETERGENTS FROM NUCLEAR WASTE WATER. Gross, M. C. (Westinghouse Electric Corp., Lester, PA); Stana, R. R. Proc. Amer. Power Conf.; 34: 710-715(1972).
From 34th annual meeting of the American Power conference; Chicago, Illinois, USA (18 Apr 1972).
See CONF-720465-.

Cooling Systems

Refer also to abstract 24523.

26748 (BARC-619) HOT CONDITIONING OF COOLANT SYSTEM AND ITS EVALUATION USING CORROSION COUPONS IN AUTOCLAVE. Vartak, D. G.; Prabhu, L. H.; Shah, G. C.; Jose, C. J. (Bhabha Atomic Research Centre, Bombay (India)). 1972. 27p. Dep. NTIS (U. S. Sales Only) $3.50.
The procedure for hot conditioning metal surfaces and its evaluation using corrosion coupons in an autoclave are described. The chemical control required on the process system during hot conditioning, theoretical aspects of hot conditioning, and methods of estimating the thickness of the protective oxide coating, the base metal loss and the crud release are discussed in detail. (auth)

26749 (CEA-CONF-2139) SODIUM BOILING IN A TRANSITORY SYSTEM. Redistribution of Flow Tests and Calculations. Costa, J.; Lafay, J.; Schmitt, F.; Rousseau, J. C. (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires; Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). 1971. 20p. (In French). (CONF-721006-6). Dep. NTIS (U. S. Sales Only).
From International Conference on Engineering of Fast Reactors for Safe and Reliable Operation; Karlsruhe, Federal Republic of Germany (F.R. Germany) (9 Oct 1972).
The phenomenon of flow excursion was analyzed for the cases of a shutdown of the pumps on their inertia and without rod drop. The results show that the flow excursion is not an instantaneous event. Three steps were observed in the progression of the boiling. The first step is the initiation of the boiling in which the temperature is increased very little and the flow remains almost constant. In the second step the flow excursion itself occurs. A third phase, lasting two to three seconds, then appears in which the flow oscillations become periodic with a high amplitude and a very low mean value. 6 references. (JSR)

26750 (CONF-721106-6) SODIUM BOILING. Fauske, H. K. (Argonne National Lab., Ill.). 1972. 35p. Dep. NTIS $3.75.
From 65th annual meeting of the American Institute of Chemical Engineers; New York, NY (26 Nov 1972).
Several modes of sodium boiling of importance in LMFBR safety analysis, including bulk, local, and explosive boiling are discussed. Bulk boiling which is of interest in analysis of unprotected whole-core accidents and certain local-core accidents (complete and partial inlet flow blockages to a subassembly) is generally unstable. Incipient superheat, flow regime, liquid-film thickness and behavior, dryout, and rewetting phenomena associated with this boiling regime are discussed. Local boiling is illustrated by considering a blockage within a reactor subassembly sufficiently large to be detected by an outlet thermocouple and/or flowmeter. This type of boiling is shown to be stable and is therefore unlikely to lead to rapid fuel-pin-failure propagation. Explosive boiling or homogeneous nucleation can readily take place in liquid-liquid systems and is therefore of interest in analyzing molten fuel-coolant interaction. This boiling mode appears to explain observed vapor explosions in laboratory experiments with LMFBR materials. (auth)

26751 (DP-Report-635) IMPROVED PRIMARY CIRCUIT MAINTENANCE TECHNIQUES: THE REMOVAL OF E PRIMARY HEAT EXCHANGER. Dragon Project. Gray, P. S.; Hamilton, J. D.; Lewis, R.; Sage, R. (Atomic Energy Establishment, Winfrith (England)). Mar 1969. 36p. Dep. NTIS (U. S. Sales Only) $4.00.
The removal and reinstallation of a primary heat exchanger in the Dragon reactor using simplified techniques are described. Access of air to the core is allowed and considerable savings in time and effort achieved. The effort of these relaxations on the purification of the coolant during subsequent start-up is discussed. (auth)

26752 (DP-Report-653) FRETTING EXPERIMENTS CARRIED OUT ON DRAGON HEAT EXCHANGER COMPONENTS. Dragon Project. Barnes, D.; Woodley, H. (Atomic Energy Establishment, Winfrith (England)). Dec 1969. 28p. Dep. NTIS (U. S. Sales Only) $3.50.
Water side corrosion which resulted in frequent tube failures in Dragon primary heat exchangers during operation in 1968, led to an extensive program of redesign and manufacture of replacement heat exchangers for installation in the reactor early in 1970. As one result of the first investigations into these failures some heat exchangers were redesigned using Incoloy 800 tubes. The tube bundles in Dragon heat exchanger designs are clamped, to minimize vibration, to a supporting structure. In the original heat exchangers with mild steel tubes these clamps had been made from stainless steel and the satisfactory performance of this material combination was confirmed by subsequent examination of those heat exchangers removed from the Dragon core. The change to Incoloy 800 tube material and limited changes to the bundle geometry led to new proposals for clamp design and different material combinations. It was considered that, in the very pure helium environment of the reactor fretting corrosion or galling of the higher alloy materials at the clamps (where relative motion, in some degree, could be expected) might be a significant problem and that the performance of proposed clamp designs and material combinations should be investigated experimentally. Since it was not considered possible to predict the precise conditions with regard to vibration frequency, amplitude of movement or contact loading occurring in the reactor it was decided that these tests should be of a comparative nature using the components of the original tube and tube clamp designs as a datum in a series of identical tests. The test results are presented. (auth)

26753 (GEAP-10580-1) SODIUM-HEATED STEAM GENERATOR MODEL TESTS AT SGTR. Volume 1. Test Rig Operating Experience and Cleaning, Disassembly, and Inspection of the Steam Generator Test Models. Scott, J. M.; Armijo, J. S.; Licina, G. J.; Diaz, T.; Gaul, G. G. (General Electric Co., Sunnyvale, Calif. Breeder Reactor Dept.). Jun 1972. Contract AT(04-3)-189. 127p. Dep. NTIS $5.45.
The test rig operating experience performed by the Breeder Systems Test Unit including the operational involvement in the task of cleaning the test models, removing the bundles from their shells, and the requisite preliminary inspection prior to the turning over of the test bundle to the Plant Materials and Processing Unit is described. The observations made by the Plant Materials and Processes Unit as a result of the cleaning, detailed disassembly, and postoperational inspection of the bundles are reported. (auth)

26754 (GEAP-10580-2) SODIUM-HEATED STEAM GENERATOR MODEL TESTS AT SGTR. Volume 2. Thermal-Hydraulic Performance Data and Analysis. Hunsbedt, A. (General Electric Co., Sunnyvale, Calif. Breeder Reactor Dept.). Jun 1972. Contract AT(04-3)-189. 205p. Dep. NTIS $7.60.
The results of steam generator model tests conducted in a sodium-heated test facility at sodium temperatures up to 950°F and steam pressures of 1600 psia are presented. The results include overall heat transfer coefficients and sodium-side heat transfer correlation for a seven-tube bayonet tube evaporator employing swirl flow generator inserts on the steam-side as well as departure from nucleate boiling (DNB) data and a heat transfer correlation for this geometry. The steam-side heat transfer characteristic beyond DNB was evaluated and the wall temperature fluctuations associated with DNB were studied. The steam-side stability characteristics of the evaporator were tested and evaluated. The results also include overall heat transfer coefficients for the coil region of a helical coil superheater containing two active tubes with steam exit temperatures up to 930°F. Sodium temperature distribution data for both models are presented along with data on sodium flow, temperature, and level fluctuations which were observed during the tests. (auth)

26755 (GEAP-13919-1) LMFBR HEAT EXCHANGER MATERIALS DEVELOPMENT PROGRAM. First Quarterly Report, October 1971-August 1972. (General Electric Co., Sunnyvale, Calif. Breeder Reactor Dept.). Sep 1972. Contract AT(04-3)-189. 46p. Dep. NTIS.
The LMFBR heat exchanger materials development program was undertaken to develop design data and operation requirements for heat exchanger materials used in a sodium environment. The program is divided into three tasks which include studies of: local corrosion of heat exchanger materials in water-contaminated

sodium systems; effects of interstitial transport on design properties of heat exchanger materials; and stress corrosion, localized corrosion, and general corrosion of heat exchanger materials. Progress in designing and operating test facilities to perform these tasks is described. (LCL)

26756 (INIS-mf-93) COOLING OF NUCLEAR POWER STATIONS. Sasek, J. 12p. (In Czech). (CONF-701214-10). INIS.

From 5th conference on nuclear power; Piestany, Czechoslovakia (1 Dec 1970).

Cooling of nuclear power stations under Czechoslovakian conditions is discussed. Owing to the fact that most Czechoslovakian rivers have a low flow volume which varies throughout the year, cooling of nuclear power stations is now envisaged only with water circulating in cooling towers. However, future construction of nuclear power stations at river dams is not excluded. (INIS)

26757 (KFK-1653) VELOCITY AND TEMPERATURE DISTRIBUTIONS IN FUEL ROD BUNDLES WITH SYMMETRICAL AND ASYMMETRICAL GEOMETRY. Hofmann, F. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Reaktorentwicklung). Jan 1973. 88p. (In German). Dep. NTIS (U. S. Sales Only) $6.50.

A mathematical model was developed which permits, for asymmetric bundle geometries, calculation of the two-dimensional (azimuthal and axial direction) temperature and turbulent velocity fields in a coolant under thermally transient conditions. This is coupled with a 3-dimensional determination of the temperature distribution in the fuel and the cladding. Mixing of the coolant is taken into account by appropriate equations for the diffusivities of momentum and energy. All physical properties are functions of the temperature and pressure. The results are compared with experimental results. The analysis was applied to the sodium cooled fast breeder reactor SNR. For this example the effects of different rod displacements upon the velocity and temperature fields in the coolant and the cladding and fuel, respectively, are discussed. (auth)

26758 (TRG-Report-2270) ACOUSTICALLY EXCITED VIBRATIONS OF A FLAT STRIP IN A LIQUID SURFACE. Bentley, P. G.; Rowley, R.; Firth, D. (United Kingdom Atomic Energy Authority, Risley (England). Reactor Group). Dec 1972. 14p. Dep. NTIS (U. S. Sales Only).

The vibration characteristics of a flat strip of steel, held in a liquid surface and excited by an acoustic pressure field in the liquid, have been investigated. The presence of boundaries at the end of the strip is shown to produce flexural waves in the strip, the amplitudes of which are dependent on the exact nature of the boundaries. This boundary effect is suggested as a mechanism for the transfer of energy to axial flexural waves which have been observed in the previous work on cylindrical tanks. (auth)

26759 (ZJE-123) VIBRATIONAL STABILITY OF GAS-FILLED CYLINDRICAL SHELL. Pecinka, L. (Skoda Works, Pilsen (Czechoslovakia). Nuclear Power Construction Dept.). 1972. 23p. Dep. NTIS (U. S. Sales Only).

Using the equations of motion of a cylindrical shell and the equation of propagation of pressure vibrations, the governing equation for calculation of frequency spectrum of the shell is obtained. For a broad interval of interaction function values, the conditions of dynamic stability are given. 9 references. (auth)

26760 METHOD FOR DETERMINING THE FISSION RADIOIODINE CONTENT IN THE WATER COOLANT OF NUCLEAR REACTORS. Kuleff, I.; Todorovsky, D. (Univ., Sofia). Kernenergie; 15: No. 11-12, 381-383(1972). (In German).

A method is proposed for determining the fission radioiodine content in the water coolant of nuclear reactors. The iodine occurring in the water coolant in any possible oxidation state is reduced to the elementary state by oxidation with NaOCl followed by reduction with $NH_2OH \cdot HCl$. After extraction by CCl_4 and adsorption on activated charcoal the gamma-ray spectrum of the preparations obtained in this way is studied using a multichannel analyzer with NaI(Tl) detector. The proposed method requires less time (about 30 min) and the preparations obtained are more convenient for further treatment. Appropriateness of the method has been shown by identification and quantitative determination of the fission isotopes ^{131}I, ^{132}I, ^{133}I, ^{134}I, ^{135}I in the water coolant of the primary loop of the Sofia research reactor IRT-2000. 18 references. (auth)

26761 INERT-GAS TRANSPORT IN LIQUID METALS DURING BOILING EXPERIMENTS. Holtz, R. E.; Fauske, H. K.; Eggen, D. T. (Argonne National Lab., IL). Int. J. Heat Mass Transfer; 16: No. 2, 520-524(Feb 1973).

During incipient boiling superheat tests in fast reactor systems, a free sodium surface is exposed to the cover gas blanket. A diffusion model is presented to demonstrate the existence of an inert gas partial pressure in the surface cavities of the heater surface. The results illustrate that the transport of inert gas into the heater surface is significant. Calculated results of inert gas diffusion into a sodium–argon system show that rather a long time may be required for the gas to diffuse into the surface cavities of an isothermal system. When forced convection effects are present the time will be much shorter. (UK)

26762 HIGH TEMPERATURE REACTORS IN FRANCE. Pelce, J. (Centre d'Etudes de Limeil, Villeneuve-Saint-Georges, France); Brisbois, J.; Delpeyroux, P.; Patarin, L.; Audinet, M.; Baschwitz, R.; Martin, G. Bull. Inform. A.T.E.N. (Ass. Tech. Energ. Nucl.); No. 96, 29-40(Jul 1972). (In French).

High energy reactors are considered. New techniques were developed for the manufacture and quality control of different types of fuel elements. Numerous irradiations are currently being carried out or terminated. The different fuel elements and fuel cycles are compared (performance and cost of cycle). Various studies concerning thermal insulation and the cooling loop are presented. (FR)

26763 CHANGES IN THE CONCEPTION OF THE STEAM GENERATORS AND THE INTERMEDIATE EXCHANGERS BETWEEN THE PHENIX PLANT AND THE 1200 MW(e) PLANT PROJECT. Robin, M. (CEN de Saclay, Gif-sur-Yvette, France); Perrin, R.; Pouderoux, P.; Tillequin, J. Bull. Inform. A.T.E.N. (Ass. Tech. Energ. Nucl.); No. 96, 15-28(Jul 1972). (In French).

The Phenix steam generators are described. The solutions envisaged for the 1200 MW(e) plant by Stein Industries (straight tube steam generators) and Babcock-Atlantique (helical tubes) are presented. The principal modification in relation to Phenix is the suppression of the Na re-superheating. An extrapolation of the solutions adopted for Phenix is envisaged for the intermediate heat exchangers. (FR)

26764 EXPERIENCES WITH PRECOAT FILTERS IN NUCLEAR POWER PLANTS. Becker, C. H.; Brown, J. S. (DeLaval Turbine, Inc., Florence, NJ). Proc. Amer. Power Conf.; 34: 737-742(1972).

From 34th annual meeting of the American Power conference; Chicago, Illinois, USA (18 Apr 1972).

See CONF-720465–.

Fuel Systems and Components

26765 (ANL-Trans-938) INSTANTANEOUS RELEASE OF SHORT LIVED FISSION GASES IN FUEL PINS. Chenebault, P. (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). 1970. Translation of pp 79-86 from International Congress on the Diffusion of Fission Products, Saclay, France, November 4–6, 1969. (CONF-691104-7). 10p. Dep. NTIS $3.00.

From International Congress on the Diffusion of Fission Products; Saclay, France (4 Nov 1969).

During irradiation of a UO_2 pin at specific nuclear powers reaching 1600 W/cm^3, the fission gases released were collected and analyzed by γ spectrometry. In a large field of middle powers, for the radioactive rare gases of half life greater than 14 min, the liberated fraction is inversely proportional to their disintegration constant. (auth)

26766 (BNWL-B-193) REVIEW OF THE PHYSICS OF PLUTONIUM SYSTEMS. Schmid, L. C.; Wolkenhauer, W. C. (eds.). (Battelle Pacific Northwest Labs., Richland, Wash.). Jul 1972. Contract AT(45-1)-1830. 33p. Dep. NTIS.

The status of selected portions of research on the physics of plutonium utilization in water cooled power reactors is reviewed. (JWR)

26767 (BNWL-SA-4333) AN IMPROVED MATHEMATICAL MODEL FOR TRANSIENT SUBCHANNEL ANALYSIS OF ROD BUNDLE NUCLEAR FUEL ELEMENTS. Rowe, D. S. (Battelle Pacific Northwest Labs., Richland, Wash.). 1 Jun 1972. Contract AT(45-1)-1830. 43p. (CONF-721112-8). Dep. NTIS $4.25.

From American Society of Mechanical Engineers winter meeting; New York, New York, USA (26 Nov 1972).

A more complete mathematical method for analyzing transient flow and enthalpy transport in rod bundle nuclear fuel elements during both boiling and nonboiling conditions is presented. The mathematical model is formulated much as in the previously published COBRA-III computer program. The bundle flow area is divided into flow subchannels that are assumed to contain one dimensional flow and are coupled to each other by turbulent and diversion crossflow mixing. Diversion crossflow is included to

allow for flow redistribution. An improved transverse momentum equation is now used to include both temporal and spatial acceleration of the diversion crossflow. The analysis method has also been improved by incorporating a transient conduction model to account for the thermal capacity of the fuel. Boiling and nonboiling conditions are considered by using an equation of state that relates density to enthalpy, flow, heat flux, pressure, position, and time. The mathematical model neglects sonic velocity propagation; therefore, it is limited to transients with time duration greater than the time for a sonic wave to pass through the bundle. The equations of the mathematical model are solved as a boundary-value problem by using a semiexplicit finite difference scheme that is stable for all time steps. The boundary conditions are the inlet enthalpy, inlet flow rate, and exit pressure. This method of solution is significant since it allows downstream flow disturbances to be felt at upstream locations as governed by the amount of crossflow resistance. Calculations of flow in a bundle with a partial blockage are presented to demonstrate the relatively weak effect of parameters contained in the transverse momentum equation. The relative effects of the fuel time constant and coolant transit time are discussed in terms of a rapid transient. (auth)

26768 (CENPD-79(Rev.1)) CE PELLET/CLAD THERMAL CONDUCTANCE MODEL. (Combustion Engineering, Inc., Windsor, Conn. Nuclear Power Dept.). Feb 1973. 38p.

A gap conductance model based on the FATES computer code is described which includes the parameters pellet/clad clearance, thermal expansion, pellet cracking, pellet swelling, initial fill gas, fission gas release, surface roughness, and pellet/clad contact pressure. Some results for typical fuel elements are presented. (JWR)

26769 (COO-2245-1) COOLANT MIXING IN LMFBR ROD BUNDLES. Quarterly progress report, June 1–November 30, 1972. Todreas, N. E. (Massachusetts Inst. of Tech., Cambridge. Dept. of Nuclear Engineering). Feb 1973. Contract AT(11-1)-2245. 21p. $4.00.

Research on coolant mixing in LMFBR rod bundles during the period June through November 30, 1972 is reported. The research covers bundle geometry and subchannel geometry. (JWR)

26770 (DP-Report-647) FISSION PRODUCTS IN THE DRAGON DIRECTLY COOLED ELEMENT NO. 710. Dragon Project. Brown, P. E.; Sandalls, F. J.; Inns, A. J.; Gouk, J.; Baker, H. (Atomic Energy Research Establishment, Harwell (England)). Jun 1969. 52p. (AERE-R-6093). Dep. NTIS (U. S. Sales Only) $4.75.

Directly cooled coated particle fuelled compacts, having zero, 3 mm and 6 mm fuel free zones, and bonded coated particles housed in fuel boxes, have been successfully irradiated to 37.75% FIFA, over a period of 240 days, at a peak temperature of 1140°C. Post-irradiation examination showed that retention of fission products by all of these fuel types was very good, being limited only by uranium contamination of coating and matrix graphites. (auth)

26771 (DP-Report-648) THEORETICAL INVESTIGATIONS OF COATED PARTICLE FUEL PERFORMANCE BY STRESS ANALYSIS. Dragon Project. Bongartz, K. (Atomic Energy Establishment, Winfrith (England)). May 1969. 44p. Dep. NTIS (U. S. Sales Only) $4.25.

Stress analysis was performed on the so-called Dragon reference particle, the Studsvik 16R, and the Studsvik 15 test fuels with the SORIN computer program. In the case of the test fuels which had been irradiated already the results of the tests were compared with the calculated stress analysis. A series of calculations on the Dragon reference particle was performed assuming different densities of the high density isotropic pyrocarbon (PyC–HDI) layer, the densities were: 1.55, 1.8, 1.95 and 2.05 g/cm^3. In another series of calculations results for different irradiation temperatures were achieved in a range between 400 and 1200°C. A parametric survey was performed on the Dragon reference particle. The parameters varied were: kernel diameter, buffer layer thickness, thickness of the PyC–HDI layers, silicon carbide layer thickness and fission gas release from the kernel. An approach was made to correlate the lifetime of the particle with each of the varied parameters. (auth)

26772 (EUR-4905) HERA-1A, HEAT TRANSFER IN ROD ASSEMBLIES. A computer programme for steady state thermohydraulic analysis of multirod fuel bundles cooled by liquid metal under nonboiling conditions. (European Atomic Energy Community, Ispra (Italy). Joint Nuclear Research Center). Feb 1973. 160p. Dep. NTIS (U.S. Sales Only). EUR B.Fr. 210.-.

A description of HERA-1A, a computer program for steady state thermohydraulic analysis of multirod fuel bundles with liquid metal cooling, is given and the physical model and mathematical procedures underlying the program are described. A complete listing of the program with sample output is given as appendix. (auth)

26773 (EURFNR-1040) INVESTIGATIONS OF THE COMPATIBILITY BEHAVIOR OF FUEL RODS USING SIMULATED FISSION PRODUCTS AND UO_2. Goetzmann, O.; Hofmann, P. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Material und Festkoerperforschung). Jul 1972. 180p. (KFK-1619). Dep. NTIS.

Work performed under United States–Euratom fast reactor exchange program.

A research program on the reaction possibilities of fission products with cladding materials is described. Various cladding materials were annealed out-of-pile in contact with simulated fission products and mixtures thereof in presence and absence of UO_2. The results of these annealing tests are represented by many micrographs and microprobe pictures. As in other investigations it was also found here that reactions between Cs and the cladding materials are only possible in the presence of oxygen or at a certain oxygen potential in the system. Te and Se are also aggressive fission products. Their reactions with the clad do not depend on the oxygen potential in the same way as those with Cs do. J and Br in the unbonded state cause severe attack on the cladding materials. Bound to Cs as CsJ or CsBr, respectively, they are not dangerous. With surplus oxygen in the system, however, reactions with CsJ or CsBr and the cladding materials take place due to further bonding of the Cs. Other fission products like Sb, Cd, In and Sn may react with the cladding materials, too. (auth)

26774 (EURFNR-1053) AXIAL DISTRIBUTION OF SEVERAL FISSION PRODUCTS IN FUEL RODS OF THE IRRADIATION EXPERIMENT DFR-350. Smailos, E.; Geithoff, D. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Material und Festkoerperforschung). Oct 1972. 73p. (KFK-1648). Dep. NTIS $5.75.

Work performed under United States–Euratom Fast Reactor Exchange Program.

The axial distribution of several fission products was determined by γ-spectrometry in 15 mixed oxide fuel pins from the irradiation experiment DFR-350. Large variations in the local concentrations were found for the nuclide Cs-137. Two different distribution patterns were discernable one having the maximum concentration at the upper end, the other with the maximum at the lower end of the fuel column. Coolant outlet temperatures during irradiation have been found to be low for Cs-enrichments at the bottom end of the pins while high temperatures correspond to enrichments at the top end. An explanation for this effect based on the reaction kinetics of cesium is offered. The distribution of the other nuclides measured has shown no peculiarities. The question whether cesium is movable within the pin even after the end of irradiation was tested in an experiment. A pin was heated in a temperature gradient ranging from 300 to 640°C for several hours. With this procedure the cesium could not be induced to move. By this way it is clearly established that slight temperature changes during post-irradiation examination are not capable of moving the fission product cesium. (auth)

26775 (GEAP-10028-44) SODIUM-COOLED REACTORS CORE ENGINEERING PROGRAM. Forty-fourth quarterly Report, August–October 1972. (General Electric Co., Sunnyvale, Calif. Breeder Reactor Dept.). Nov 1972. Contract AT(04-3)-189. 127p. Dep. NTIS.

Progress during August, September and October 1972 is described for tasks related to fuel rods, fuel rod assemblies, core restraint, control and blanket assemblies, and defected fuel. (auth)

26776 (GEAP-13735) PERFORMANCE OF UNENCAPSULATED $(U,Pu)O_2$ FUEL PINS (SERIES F3A) IRRADIATED IN EBR-II TO 50,000 MWd/Te. McCarthy, W. H.; Bennett, J. W.; Hull, G. R.; Perry, K. J. (General Electric Co., Sunnyvale, Calif. Breeder Reactor Dept.). Nov 1971. Contract AT(04-3)-189. 186p. Dep. NTIS.

Sixteen unencapsulated mixed-oxide fuel pins were irradiated in EBR-II to approximately 5 atomic percent burnup at 16 kW/ft nominal peak linear power. The fuel fabrication parameters were varied within the ranges proposed for commercial liquid metal fast breeder reactors (LMFBR) except that pin diameter was approximately 15% larger than usually specified. No cladding failures occurred. Pin swelling was substantially greater in Type-304L stainless steel clad fuel pins than in Type-316 clad elements. Fission gas release to the internal void volume ranged from 73 to 97%. Experimental burnup values were 10 to 12% less than calculated values and varied across the subassembly in a manner that suggested

some fission rate elevation from an adjacent extra-worth driver subassembly. Substantial attack was found in the cladding at its inside surface and the extent of this attack (up to 0.009 inch intergranular penetration at about 1158°F) correlated with temperature but not with any fuel fabrication parameter. The penetrating fission product material contained Cs, Mo, and Te. The unusually large amount of fuel/fission product/cladding reaction may be related to the high carbon content in the mixed oxides and/or to a short high temperature operating period. (auth)

26777 (GU-5286) POST-IRRADIATION EXAMINATION OF HIGH DENSITY URANIUM–PLUTONIUM CARBIDE FUEL RODS IN EBR-II TO 65,000 MWd/t BURNUP. (Gulf United Nuclear Fuels Corp., Elmsford, N. Y.). Dec 1972. Contract AT(11-1)-3059. 71p. AT $5.45.

The post-irradiation examination of nine helium-bonded, mixed-carbide fuel rods irradiated in the EBR-II was made at Los Alamos Scientific Laboratory. The fuel was in the form of high-density (97 ± 3% of theoretical), solid-solution uranium-plutonium carbide pellets, with a structure of MC + 10 v/o M_2C_3 [M = $(U_{0.8}Pu_{0.2})$]. The fuel was prepared by the carbothermic reduction of the dioxides of uranium and plutonium followed by cold pressing and sintering of pellets. The cladding was solution annealed Type 316 stainless steel and Incoloy-800 alloy. Two rods (UNC 89 and UNC 90) contained four segments each, while the remainder were full length prototypic rods, all designed to test and evaluate the effects of annular fuel-clad gap and cladding strength. Visual examination of the rods showed that three out of four rods clad in Incoloy-800, including the multispecimen rod, were in excellent condition after irradiation, while all Type 316 stainless steel clad rods had severe circumferential and/or longitudinal cracks. Incoloy-800 performed better than Type 316 stainless steel in every respect. (auth)

26778 (GULF-GA-A-12502) DESCRIPTION OF THE REPLACEMENT MIXED-OXIDE FUEL-ROD CAPSULES FOR THE F-1 (X094) HIGH TEMPERATURE FAST-FLUX IRRADIATION EXPERIMENT. Flynn, P. W.; Hinz, R. F.; Langer, S.; Lindgren, J. R.; Washburn, T. N. (Gulf General Atomic Co., San Diego, Calif.). 9 Feb 1973. Contract AT(04-3)-167. 44p. Dep. NTIS $4.25.

The objective of the F-1 (X094) fast-flux experiment being irradiated in EBR-II is to study $(U,Pu)O_2$ fuel-rod specimens with cladding temperatures in the range of 650 to 800°C and at linear power-generation rates of 14 to 16 kW/ft. The F-1 (X094) subassembly started irradiation in March 1971. At 50,000 MWd/Te burnup, five of the seven capsules will be removed and replaced with unirradiated encapsulated fuel rods. The mixed-oxide fuel is contained in 20% cold-worked Type 316 stainless steel and will achieve burnups ranging from 5.3 to 10.7% FIMA. The capsules are, in general, the Mark B-7B type with a stainless steel annular thermal barrier sodium-bonded to the fuel rod and to the capsule tube. Silicon carbide temperature monitors and dosimeters are placed in various positions along the thermal barrier to allow postirradiation determination of capsule temperatures utilizing dimensional changes during isochronal annealing of the SiC and to determine axial flux distribution by dosimetry analysis. All of the fuel rods will contain activated charcoal traps to determine the effects of fast-neutron irradiation on the sorption characteristics of the charcoal for fission products. (auth)

26779 (HEDL-SA-340) CORRELATED FISSION GAS RELEASE MODEL FOR FAST REACTOR. Dutt, D. S.; Bullington, D. C.; Baker, R. B.; Pember, L. A. (Hanford Engineering Development Lab., Richland, Wash.). 1972. Contract AT(45-1)-2170. 14p. (CONF-720607-30). Dep. NTIS.

From 18th Annual American Nuclear Society Conference; Las Vegas, Nevada, United States of America (USA) (18 Jun 1972).

A fission gas release model was developed to predict the gas released to the plenum during steady state operation of a mixed oxide fuel pin in a fast reactor. 5 references. (auth)

26780 (HEDL-SA-393) FAST REACTOR SAFETY IMPLICATIONS OF RECENT ASSESSMENTS OF FUEL PIN TRANSIENT BEHAVIOR. Culley, G. E.; Hanson, J. E.; Partain, W. L.; Scott, J. H.; Waltar, A. E. (Hanford Engineering Development Lab., Richland, Wash). 1972. Contract AT(45-1)2170. 31p. (CONF-721006-7). Dep. NTIS.

From International Conference on Engineering of Fast Reactors for Safe and Reliable Operation; Karlsruhe, Federal Republic of Germany (F.R. Germany) (9 Oct 1972).

An experimentally based assessment of mixed oxide fuel pin response to transient overpower conditions in sodium cooled fast reactors is presented. The implications of such behavior on whole core accident sequences are discussed. (JWR)

26781 (JAERI-M-4794) DEVELOPMENT OF JPDR-II INSTRUMENTED FUEL ASSEMBLY (IFA No. 4–No. 7). Yokota, M.; Yamada, M.; Honma, T. (Japan Atomic Energy Research Inst., Tokyo). Sep 1972. 160p. (In Japanese). NTIS (U. S. Sales Only).

The development of instrumented fuel assemblies carried out in the JPDR-II Project is described. Four instrumented fuel assemblies IFA were manufactured, each of which is installed with one turbine flow meter and two C/A thermocouples to measure the reactor coolant temperature at the fuel inlet and outlet, one impedance void gauge at the fuel outlet, two W/W 26% Re thermocouples to measure the UO_2 pellet center temperature, and two β current detectors (Rh emitter) at the center of fuel assembly. Design philosophy and specification for the IFA design and out pile tests of various instruments, design and tests of the pressure seal for the pressure vessel penetration, measuring devices and data treatment of IFA signals, strength analyses and safety evaluation of instruments and other accessories are given. The IFA have been installed in the JPDR-II core since March 1972 and are showing a successful performance for the JPDR-II high power density test. (auth)

26782 (JAPFNR-84) FAST REACTOR FUEL BEHAVIOUR UNDER A THERMAL GRADIENT. 1. Determination of Void Migration Rate in UO_2 Pellet. Koizumi, M.; Kawamata, H.; Sakai, K.; Kaneko, H.; Sasao, N.; Komatsu, J. (Power Reactor and Nuclear Fuel Development Corp., Tokai (Japan)). Jun 1972. 27p. (N-841-72-09). Dep. NTIS (U. S. Sales Only) $3.50.

Measurement of actual migration rate of voids was made on sintered UO_2. Two thin disks of high density UO_2 pellet were placed one over the other and resintered to form voids along the interface. Then the specimen was heated in an induction furnace under temperature gradient of about 3,000 to 5,000 °C/cm for one to nine hours. Void migration distance was obtained from metallographic pictures of ground and polished cross section of the specimen. Temperature gradient in the region was estimated from measurements on the overall specimen. The results were compared with theories and the measured migration rate of voids was close to the theoretical values determined by Sens. (auth)

26783 (JUL-894-RG) CONTRIBUTION TO COMPARE FUEL RODS AND FUEL BALLS AS FUEL ELEMENTS FOR HIGH-TEMPERATURE REACTORS. Heil, J. (Kernforschungsanlage, Juelich (West Germany). Institut fuer Reaktorentwicklung). Oct 1972. 132p. (In German). Dep. NTIS (U. S. Sales Only) $8.75.

Fuel rods and fuel balls for high-temperature reactors are calculated and compared with each other on the basis of a 600 MW(e) power plant with regard to temperature distributions and thermodynamic sizes for wide range of parameters. The different fuel rods are reduced to simple models with reference to the DRAGON types. The average outlet-temperature of cooling gas is constantly kept at 850°C, and the radial power distribution is varied independently and uniformly to permit a comparison for all cores. It is shown that fuel rods can have lower temperatures than fuel balls. Fuel rods of the pressed model show the lowest fuel temperatures; the surface temperatures, however, do not vary significantly. Fuel and surface temperatures of a pebble-bed core according to the OTTO (Once Through Then Out) loading scheme are incorporated into the comparison, too, and show a decrease particularly of the fuel temperature in comparison to a core of the conventional power distribution. The pressure loss of a core with fuel rods can be kept lower than that of a corresponding pebble-bed. The maximum temperature gradients of fuel balls arising in stationary operation are sometimes much below the values of fuel rods. (auth)

26784 (JUL-901-RG) NUCLEAR STUDIES ON A PEBBLE-BED REACTOR WITH DISCONTINUOUS REMOVAL OF FUEL BALLS. Baeumer, R.; Bonka, H.; Mueller, K. (Kernforschungsanlage, Juelich (West Germany). Institut fuer Reaktorentwicklung). Nov 1972. 43p. (In German). Dep. NTIS (U. S. Sales Only) $4.25.

A pebble-bed reactor is considered with a discontinuous one-way loading scheme of the thorium or uranium fuel cycle with regard to thermodynamics and nuclear techniques, and compared with the continuous one-way loading scheme of the pebble-bed reactor. Because of the required excess-reactivity of the discontinuously fueled pebble-bed reactor, the fuel-cycle costs become remarkably higher than those of the continuously fueled one. Due to the high breeding ratio, the increase of the fuel-cycle cost is the lowest with the thorium fuel cycle. These results might also be valid for a high-temperature reactor with prismatic fuel elements. (auth)

26785 (KFK-1522) DESIGN, IRRADIATION, AND EXAMINATION OF THE UO_2–PuO_2-FUEL-PIN-BUNDLE MOL-7A. Kum-

merer, K.; Geithoff, D.; Weimar, P. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Material und Festkoerperforschung). Nov 1972. 213p. (In German). Dep. NTIS (U. S. Sales Only) $12.75.

Within the fuel pin development for fast breeder reactors the irradiation experiment Mol-7A comprises the irradiation of a fuel pin bundle with 7 pins in the epithermal neutron flux of the Belgian reactor BR 2. The bundle was loaded in the sodium circuit in the central channel of the BR 2, the so-called MFBS-5-Loop. The pins contained UO_2-PuO_2 fuel in a stainless steel cladding. The design of the pins with respect to material composition and geometry as well as the operational conditions is highly representative for the conditions in a fast breeder prototype like the SNR 300. Having a PuO_2-content of 20 wt %, the smeared density of the fuel was 80% of theoretical density. The claddings which consisted of 3 quite similar types of high temperature resistant stainless steels had a 0.38 mm wall thickness. The pin diameter was 6.0 mm. As far as the pin length is concerned the simulation of true fast reactor conditions was not possible due to the limited irradiation space in the BR 2. The ratio between fuel volume and fission gas plenum, however, is representative for a fast reactor pin. In a total pin length of 108 cm a 50 cm long fuel region is located between upper and lower small axial blankets, each accompanied by a separate gas plenum. The operational conditions during irradiation were designed to be 500 watts/cm for the pin rating and 630°C for the maximum cladding temperature. In the course of the experiment the power happened to be remarkably higher, up to about 590 watts/cm. The target burnup was 60,000 megawatt days/t M, but only about 45,000 MWd/t were reached, when the experiment had to be terminated due to a pin failure. (auth)

26786 (KFK-1724) MECHANICAL PERFORMANCE ANALYSIS OF A SUBASSEMBLY BOX SUBJECT TO CREEP AND SWELLING. Liebe, R. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Reaktorentwicklung). Dec 1972. 79p. (In German). Dep. NTIS (U.S. Sales Only) $5.75.

Thermal bowing as well as irradiation induced material creep and swelling determine the mechanical performance of fast breeder reactor subassemblies. Therefore the safe and economic core design requires suitable analytical methods. In particular the plane bending problem of a single subassembly box is treated and a simple incremental method is described allowing to calculate the time dependent stresses, forces and deflections due to thermal, creep, and swelling strains. The method is based on the beam theory, and the usual matrix methods of elastomechanics are employed to find the incremental response during each time step with given initial strains. The general analysis allows for arbitrary creep and swelling laws as well as for multiple supports, a variable bending stiffness, temperature and neutron flux density distribution. Description and application are given of a computer program. Some results for SNR-type fuel elements indicate the significance and the competing effects of in-pile creep and swelling. (auth)

26787 (NEDO-10505) EXPERIENCE WITH BWR FUEL THROUGH SEPTEMBER 1971. Williamson, H. E.; Ditmore, D. C. (General Electric Co., San Jose, Calif. Nuclear Fuels Dept.). May 1972. 47p.

An up-dated review is presented of experience and developmental data obtained with BWR Zircaloy-clad UO_2 fuel through September, 1971. The discovery of a fuel rod failure mechanism which had not been previously identified in production Zircaloy-clad UO_2 fuel is described. The failures due to this mechanism, which have been identified in only one commercial power reactor (Dresden Unit-1) to date, appear to occur in a statistically small fraction of fuel rods after several cycles of operation. The mechanism has been recently reproduced in some irradiated fuel rod segments in the General Electric Test Reactor (GETR). Based on the data available to date the failures are judged to be caused by strain localization due to pellet-to-cladding interaction at pellet cracks and ridges, combined with the observed statistical variability in cladding strain capability. A value of 1% plastic strain of Zircaloy cladding remains as the defined limit below which fuel damage due to overstraining is not expected to occur. However, it is now recognized that the statistical variability in cladding material properties results in a finite, but small (<5%), probability that a cladding segment will have total plastic strain capability of less than 1%. The linear heat generation rate required to cause 1% diametral plastic strain of the cladding is calculated to be ~28 kw/ft in low exposure fuel as before. The analytical and experimental bases employed in the evaluation of this limit are reviewed. 28 references. (auth)

26788 (ORNL-4852) TEMPERATURE DISTRIBUTION IN THE DUCT WALL AND AT THE EXIT OF A 19-ROD SIMULATED LMFBR FUEL ASSEMBLY (FFM BUNDLE 2A). Fontana, M. H.; Gnadt, P. A.; MacPherson, R. E.; Parsly, L. F.; Wantland, J. L. (Oak Ridge National Lab., Tenn). Apr 1973. Contract W-7405-eng-26. 70p. AT $5.45.

Experiments were performed with a 19-rod test assembly in the Failed-Fuel Mockup (FFM) flowing sodium loop in which Liquid-Metal Fast Breeder Reactor (LMFBR) fuel rods were simulated by electrical cartridge heaters having the same external configuration, spacer arrangement, temperature, and heat flux as those of the Fast-Flux Test Facility (FFTF). Temperatures were measured within the rod bundle, at the exit, and along the duct walls of the rod assembly for widely varying conditions of flow and power density and for nonuniform radial power distribution. Significant differences in temperature were measured around the duct periphery, which appeared to be linearly dependent on the power density. Flow reduction caused a decrease in the measured temperature differences. Temperatures at the exit of interior subchannels agree with analytical predictions, whereas temperatures of peripheral channels indicate the existence of significant swirl flow around the rod bundle, which can be best predicted analytically by a separate treatment of the edge channels. In-situ radiographs indicate distortion of the rod bundle toward the duct wall at elevations where the spiral wire-wrap spacers do not touch the duct wall. At each elevation, the circumferential temperature profile is related to the position of the wire-wrap spacers relative to the duct wall, in that higher temperatures were measured on the duct wall opposite from that which contacts the spacers. The differences in temperature around the duct periphery are of sufficient magnitude that their effect should be considered in evaluating temperature-dependent material growth due to fast-neutron irradiation. (auth)

26789 (ORNL-TM-4075) PROGRESS REPORT ON LMFBR SAFETY PROGRAMS FOR SEPTEMBER–OCTOBER 1972. Cottrell, W. B. (Oak Ridge National Lab., Tenn.). Feb 1973. Contract W-7405-eng-26. 56p. AT $5.45.

LIQUID METAL FAST BREEDER REACTOR—safety program during September and October 1972
—fuel element failures in, research during September and October 1972 on
REACTOR FUEL ELEMENTS—failure of sodium cooled fast, research during September and October 1972 on

26790 (ORNL-TM-4088) PROGRESS REPORT ON LMFBR SAFETY PROGRAMS FOR NOVEMBER–DECEMBER 1972. Cottrell, W. B.; Fontana, M. H. (Oak Ridge National Lab., Tenn.). Feb 1973. Contract W-7405-eng-26. 63p. AT $5.45.

LIQUID METAL FAST BREEDER REACTOR—safety program during November and December 1972
—fuel element failures in, research during November and December 1972 on
REACTOR FUEL ELEMENTS—failure of sodium cooled fast, research during November and December 1972 on

26791 (RT/ING-(72)12) STUDIES AND PRELIMINARY OUT OF PILE TESTS RELATED TO SODIUM FUEL INTERACTION. Martini, M.; Crisafulli, N.; Sacco, A.; Scarano, G.; Stefanovic, M. (Comitato Nazionale per L'Energia Nucleare, Rome (Italy)). 28 Jun 1972. 52p. (CONF-720665-2). Dep. NTIS (U. S. Sales Only).

From Reunion of Specialists of CREST-ENEA on the Combustible Sodium Interaction from the Point of View of the Safety of Fast Reactors; Grenoble, France (Jun 1972).

Schemes of different accident situations are presented in which the Sodium Fuel Interaction (S.F.I.) research role is seen. A description of the Unità Sperimentale Technologie Sodio (USTS) out of pile experimental rigs and techniques is presented and the sodium-fuel interaction code FUS-PEC is described together with calculation results. (auth)

26792 (WARD-3045-T-2-B-8) RADIAL BLANKET DESIGN AND DEVELOPMENT. Quarterly Progress Report for Period Ending November 30, 1972. Bishop, E. C. (Westinghouse Electric Corp., Madison, Pa. Advanced Reactors Div). 1972. Contract AT(11-1)-3045. 77p. AT $5.45.

Progress on the design and development of LMFBR radial blankets during the period September 1 through November 30, 1972 is reported. Research during the period was primarily concerned with heat transfer and irradiation testing. (JWR)

26793 (WCAP-7958(Add.1)) DNB TEST RESULTS FOR R GRID THIMBLE COLD WALL CELLS. Motley, F. E.; Cadek, F. F. (Westinghouse Electric Corp., Pittsburgh, Pa.). Oct 1972. 27p.

Two sets of type "R" mixing vane grid DNB data from a 4 × 4 rod bundle, where one of the central rods is a simulated control rod thimble, are presented. The results show that the W-3 cor-

relation with cold wall factor and the Modified Spacer Factor is applicable to "R" grid thimble cold wall rod bundle data. (auth)

26794 FUEL ELEMENT FOR HIGH-TEMPERATURE REACTORS. (to Nukem Nuklear Chemie and Metallurgie GmbH). Belgian Patent 741,879. 18 Nov 1969. Priority date 13 Jun 1969, Federal Republic of Germany (F.R. Germany).

A description is given of a fuel element for high-temperature reactors with direct cooling of the body of the fuel. The element consists of a preferably cylindrical fuel body consisting of a homogeneous mixture of a matrix of carbon and of coated fuel particles and of a sheath free of particles surrounding it. The carbon matrix is held in place by use of crossbraces in a graphite tube or in holes in a graphite block. (BE)

26795 MODEL STUDIES ON STRETCH-OUT OF BURN-UP BY DECREASING THE LOAD OF A REACTOR. Meyer, K. (Ingenieurhochschule, Zittau, Ger.). Kernenergie; 15: No. 10, 340-344(Oct 1972). (In German).

Using a simple one-group model a study is made on fuel saving at fixed operating time or stretch-out of the operating time at fixed amount of fuel to be recharged. This may be attained when the load is decreased at the end of the cycle as compared with no decrease of load regime. Fuel saving at fixed operating time turns out to be several percent. (auth)

26796 AXIAL GROWTH OF WATER-REACTOR FUEL RODS. Chernock, W. P.; Stewart, J. R. (Combustion Engineering, Inc., Windsor, CT). Proc. Amer. Power Conf.; 34: 163-178(1972).

From 34th annual meeting of the American Power conference; Chicago, Illinois, USA (18 Apr 1972).

See CONF-720465-.

26797 FUEL PERFORMANCE IN THE BWR. Klepfer, H. H.; Richards, R. B.; Trocki, T. (General Electric Co., San Jose, CA). Proc. Amer. Power Conf.; 34: 169-178(1972).

From 34th annual meeting of the American Power conference; Chicago, Illinois, USA (18 Apr 1972).

See CONF-720465-.

In an evaluation of fuel performance for Zircaloy clad UO_2 fuel used in BWR type reactors, two types of failures were identified. These failures are hydride internal corrosion and cracks in the cladding. Moisture residuals from fabrication are the prevailing source of hydrogen for internal hydride corrosion. Application of hot vacuum outgassing and total rod moisture control results in reducing moisture to about $^1/_{10}$th of the quantity which causes corrosion. Design changes have reduced cracks caused by UO_2-Zircaloy interaction. Increased final clad heat treatment temperature insures full recovery of cold work resulting in increased preirradiation ductility. The thickness of the cladding has also been increased. (FS)

26798 WESTINGHOUSE NUCLEAR-FUEL OPERATING EXPERIENCE. Dollard, W. J.; Kramer, F. W. (Westinghouse Electric Corp., Pittsburgh). Proc. Amer. Power Conf.; 34: 179-187(1972).

From 34th annual meeting of the American Power conference; Chicago, Illinois, USA (18 Apr 1972).

See CONF-720465-.

Auxiliary Systems, Protection Systems, and Engineered Safeguards

Refer also to abstract 25248.

26799 (CONF-721109-18) LOSS OF COOLANT: CONTROL OF CONSEQUENCE BY EMERGENCY CORE COOLING. Brockett, G. F.; Griebe, R. W.; Shumway, R. W.; Zane, J. O. (Aerojet Nuclear Co., Idaho Falls, Idaho). 1972. AT(10-1)-1375. 53p. Dep. NTIS.

From International conference on nuclear solutions to world energy problems; Washington, District of Columbia, USA (12 Nov 1972).

The "fault tree" method is used to identify and evaluate the sensitivity of potential analytical faults in the selection of performance requirements for a PWR emergency core cooling system. From the example studied the following is cited. If the predicted energy removal rates prior to ECC action are significantly lower than actual values, the majority of the fault states identified on the tree will be unimportant. However, if predicted energy removal rates are higher than actual values so that cladding temperature limits are approached before the lower plenum is refilled, then the subtle errors in the analysis of blowdown duration, "steam binding," friction pressure drop, application of flooding heat transfer data, and decay heat power generation rates could have significant influence on ECC performance requirements. The performance maps and discussion show for the PWR case that the cladding temperature rise after initiation of flooding is primarily influenced by the variables of flooding rate, initial decay heat power level, initial temperature, metal-water reaction, rate, and initial zirconium oxide thickness. For the BWR case, the influence of the thicker cladding and the change in location of the hot spot from a corner position to a central position in the fuel assembly during the course of the accident permits cladding temperatures considerably in excess of 2300° before a 40% embrittlement is reached. The research and development programs throughout the world are addressing many aspects of blowdown, blowdown heat transfer, and ECC heat transfer. System effects tests of the ECC delivery and potential delay in lower plenum refill are limited to a few programs in the U. S. and Japan. Improved precision in and verification of the calculational techniques used for predicting blowdown heat transfer and blowdown duration are expected to reveal conservatisms in quantifying the margins of ECC performance. Completeness is yet required in the analysis and verification of emergency core cooling delivery and lower plenum refill in order to quantify the potential margins of ECC system design. (auth)

Operation and Economics

26800 (DP-Report-621) DRAGON OPERATIONS GROUP TWELFTH QUARTERLY PROGRESS REPORT, MARCH TO MAY 1968. Dragon Project. Danby, F. (Atomic Energy Establishment, Winfrith (England)). Jan 1969. 28p. Dep. NTIS (U. S. Sales Only) $3.50.

26801 (DP-Report-630) DRAGON OPERATIONS GROUP ELEVENTH QUARTERLY PROGRESS REPORT, DECEMBER 1967 TO FEBRUARY 1968. Dragon Project. Danby, F. D. (Atomic Energy Establishment, Winfrith (England)). Jun 1969. 32p. Dep. NTIS (U. S. Sales Only) $3.75.

26802 (DP-Report-631) DRAGON OPERATIONS GROUP 13th QUARTERLY PROGRESS REPORT, 1st JUNE-31st AUGUST 1968. Dragon Project. Salter, W. B. (Atomic Energy Establishment, Winfrith (England)). Jan 1969. 26p. Dep. NTIS (U. S. Sales Only) $3.50.

26803 (DP-Report-638) DRAGON OPERATIONS GROUP FOURTEENTH QUARTERLY PROGRESS REPORT, SEPTEMBER TO NOVEMBER 1968. Dragon Project. Chapman, B. G.; Salter, W. B. (Atomic Energy Establishment, Winfrith (England)). Mar 1969. 34p. Dep. NTIS (U. S. Sales Only) $3.75.

26804 (WASH-1230(Vol. 1)) PRESSURIZED WATER REACTOR PLANT. Volume I. 1000-MWe Central Station Power Plants Investment Cost Study. (United Engineers and Constructors Inc., Philadelphia, Pa.). Jun 1972. Contract AT(30-1)-3032. 226p. Dep. NTIS $7.60.

Detailed cost data for a 1000 MW(e) pressurized water reactor power plant are presented. A technical description of the plant and an equipment list are included. This study is part of a series for reactor and fossil plants aimed at permitting cost comparisons, evaluations, and projections based on equivalent assumptions relative to site, labor, performance, and reference dates for cost data. (JWR)

26805 (WASH-1230(Vol. 2)) BOILING WATER REACTOR PLANT. Volume II. 1000-MWe Central Station Power Plants Investment Cost Study. (United Engineers and Constructors Inc., Philadelphia, Pa.). Jun 1972. Contract AT(30-1)-3032. 207p. Dep. NTIS. $7.60.

Detailed cost data for a 1000 MW(e) boiling water reactor power plant are presented. A technical description of the plant and an equipment list are included. This study is part of a series for reactor and fossil plants aimed at permitting cost comparisons, evaluations, and projections based on equivalent assumptions relative to site, labor, performance, and reference dates for cost data. (JWR)

26806 NUCLEAR POWER PLANTS OF DIFFERENT TYPES IN RELATION TO AN INTERCONNECTED POWER SYSTEM. Levai, A. (Technical Univ., Budapest). Fuel; 52: No. 1, 3-10 (Jan 1973).

The technical and economic characteristics of an interconnected power system are discussed. The capacity of a new power plant is first evaluated in relation to the enlarged system and possible peaks carried by the system are established. This determines the change of the system reserves not from an operation view but with regard to the investment costs. In establishing the schedule of the interconnected system, the distribution of loads between the individual power plants and generating units is involved. This deals with variable costs. The effect of nuclear energy on the primary use of energy must be evaluated. Optimum

utilization of uranium reserves demands the development of reactor types with increased material utilization efficiency and tenfold increase in burn-up time. (FS)

26807 PROTOTYPE FAST NEUTRON REACTOR PHENIX. Megy, J. (CEN de Saclay, Gif-sur-Yvette, France); Guillemard, B.; Robert, E.; Crette, J. P.; Labat, P. Bull. Inform. A.T.E.N. (Ass. Tech. Energ. Nucl.); No. 96, 6-14(Jul 1972). (In French).

The construction of Phenix began in 1968. General trials are currently being conducted. The principal characteristics (power, integrated conception, fuel, charging and discharging cycles) are recalled. The difficulties encountered are discussed together with the solutions adopted for the studies, trials, and manufacturing techniques, particular attention being given to the reactor block, steam generators, and the manipulation devices. (FR)

26808 MATHEMATICAL MODEL FOR LONG-TERM FORECASTING OF NUCLEAR POWER DEVELOPMENT BASED ON ECONOMIC CRITERIA. Virtser, A. D.; Levental, G. B.; Chernavskii, S. Ya. At. Energ. (USSR); 33: No. 6, 955-960(Dec 1972). (In Russian).

Nuclear power development has become a complex undertaking, requiring the use of economic-mathematical methods of analysis. A dynamic linear model is described which permits, under given external conditions of nuclear power development, determination of the optimal structure for minimal costs, the role of various types of reactors, the value of plutonium in the system, the dynamics of expenditure of natural uranium resources, etc. The outstanding feature of this model is that it accounts for specific relations between system elements as regards consumption and production of nuclear fuel and the dynamic nature of optimized parameters. Numerical calculations confirm that the proposed model is an effective tool. (auth)

26809 NUCLEAR FUEL LOGISTICS. Golan, S. (Atomics International, Canoga Park, CA); Salmon, R. Nucl. News; 16: No. 2, 47-53(Feb 1973).

Nuclear fuel logistics relate to the composite of decisions and operations necessary for efficient supply, utilization, and salvage of power reactor fuel. The supply aspects of the nuclear fuel cycle are emphasized, particularly as related to reactor systems of greatest interest in the U. S., i.e., IWR's, HTGC's, and LMFBR's. Information is included on specific fuel logistics requirements for each of these three systems, typical fuel characteristics which affect fuel logistics, industry wide requirements and forecasts on fuel costs, and the projected investment requirements for nuclear fuel facilities to the year 2000. (LCL)

26810 DIRECT-CYCLE NUCLEAR GAS TURBINE WITH ECONOMICAL DRY AIR COOLING. Krase, J. M.; Morse, D. C.; Schoene, T. W. (Gulf General Atomic Co., San Diego, CA). Proc. Amer. Power Conf.; 34: 512-520(1972).

From 34th annual meeting of the American Power conference; Chicago, Illinois, USA (18 Apr 1972).

See CONF-720465-.

The direct-cycle nuclear gas turbine, which requires a gas-cooled reactor of high outlet temperature, is the most efficient nuclear plant with the least amount of thermal discharge. It has near zero radioactivity release and eliminates combustion particle release to the atmosphere. The HTGR gas turbine makes dry air cooling economical and the reactor may be located anywhere. The reactor is almost environmentally neutral. Overall plant simplification and size reduction provide lower capital cost while obtaining the highest efficiency. (FS)

Safety and Siting

26811 (AI-AEC-13050) LMFBR SAFETY PROGRAMS. Quarterly Technical Progress Report, October–December 1972. Springer, T.; Koontz, R. L.; Johnson, R. P.; Nelson, C. T.; Baurmash, L.; Vaughn, E. U.; Heisler, M. P. (Atomics International, Canoga Park, Calif.). 15 Feb 1973. Contract AT(04-3)-824. 25p. Dep. NTIS.

LIQUID METAL FAST BREEDER REACTOR—safety programs during October through December 1972
—coolant combustion accidents in, characteristics of, (E/T)
SODIUM—combustion in liquid metal cooled fast breeder reactor accidents, (E/T)

26812 (CONF-730304-3) FAULT TREE AS A SAFETY OPTIMIZATION DESIGN TOOL. Griffin, C. W. (Atomics International, Canoga Park, Calif.). [nd]. 20p. Dep. NTIS $3.00.

From National topical meeting on water reactor safety; Salt Lake City, Utah, USA (26 Mar 1973).

Fault tree, after a very encouraging start nearly six years ago in nuclear reactor development, appeared to decline into very limited use. Some work on the Heavy Water Organic Cooled Reactor was quite successful in defining the relative safety of two containment concepts. The technique was applied to evaluation of added risk for the general public due to construction of a large sodium test facility. These two studies are discussed in detail. The techniques developed are then applied to construction of a fault tree for evaluation of both on-site and off-site risk to the owner of accident consequences in operating a large test facility complex. Recently suggested criteria are applied. (auth)

26813 (COO-2152-6) INVESTIGATION OF PRESSURE DROPS AND HEAT TRANSFER COEFFICIENTS FOR LOSS OF COOLANT EVALUATIONS. Quarterly Progress Report, Period Ending December 31, 1972. (Cincinnati Univ., Ohio. Dept. of Chemical and Nuclear Engineering). 1972. Contract AT(11-1)-2151. 7p. Dep. NTIS.

Research on heat transfer and pressure drop phenomena during a loss of coolant accident is reported for the period October 1 through December 31, 1972. The research covers transient pressure drop studies, two-phase pressure drop and flow pattern studies, and transition boiling and reflooding heat transfer tests. (JWR)

26814 (DP-Report-649) CALCULATION OF FISSION PRODUCT RELEASE FROM A POWER REACTOR. Dragon Project. Mielken, G.; Preinreich, G. (Atomic Energy Establishment, Winfrith (England)). Dec 1969. 52p. Dep. NTIS (U. S. Sales Only) $4.75.

The evaluation of fission product release from an HTGR during its lifetime of about 30 years is presented. The fission products in question are ^{90}Sr and ^{137}Cs together with their precursors ^{90}Kr and ^{137}Xe, and the reactor considered is the 1,500 MW(t) (630 MW(e)) design study of the Dragon Project. The releases are calculated for an on-load refuelled equilibrium core. 14 references. (auth)

26815 (EQL-6) UNDERGROUND NUCLEAR POWER PLANT SITING. Watson, M. B.; Kammer, W. A.; Langley, N. P.; Selzer, L. A.; Beck, F. L. (Aerospace Corp., San Bernardino, Calif.). Sep 1972. 143p. California Inst. of Tech., Pasadena, CA. $2.50.

The economic and technical aspects of underground siting are discussed for typical light water reactor nuclear power plants. Three configurations are summarized. A discussion of the underground gallery liner design and associated structural analyses is presented. Also discussed are some aspects of containment for underground plants. There it is suggested that the need for large separations between the plant and population centers may be significantly reduced, or perhaps eliminated. A brief discussion of operational considerations for underground plants is included. The costs associated with excavation and lining of the underground galleries have been estimated. These estimates include an assessment of variations implied by different seismic loading assumptions and differences in geologic media. It is shown that these costs are a small percentage of the total cost of comparable surface plants. Finally, the parameters characterizing an acceptable underground site are discussed. Material is also included pertaining to foreign underground plants, span limits of underground excavations, potential siting areas for underground plants in the State of California, pertinent data from the Underground Nuclear Test Program, and other supporting technical discussions. (auth)

26816 (EURFNR-1055) SAFETY OF SNR-300 AND THE AEROSOL MODEL. A Summary Report of the RCN Aerosol Research, 1967–1971. van de Vate, J. F. (Reactor Centrum Nederland, Petten). Jun 1972. 125p. (RCN-174). Dep. NTIS (U. S. Sales Only).

Work performed under United States–Euratom Fast Reactor Exchange Program.

Results of aerosol experiments simulating a LMFBR major accident situation are presented and discussed. Application of these results allows improvements of the present safety evaluation. The aerosol plate out under major accident conditions is governed by thermophoretic deposition on the containment walls. As a result, the aerosols inside the SNR-300 first containment will disappear exponentially with a half-life which can safely be assessed at 0.5 hours. The effect of reventing the outer containment after the accident and of the time dependence on decay heat power of the aerosol concentration are given. Experimental results on unheated aerosols are reported, however, they are less important for the safety evaluation of major reactor accidents. The final aging of unheated enclosed aerosols is governed by the combined action of stirred diffusion and settling. The thickness of the effective boundary layer for stirred diffusive deposition has been found to be about 1 mm. (auth)

26817 (EURFNR-1067) PRINCIPLES AND FEASIBILITY OF A COMPUTER-AIDED MONITORING OF THE SNR CORE. Audoux, M. (Kernforschungszentrum, Karlsruhe (West Germany). Insti-

tut fuer Reaktorentwicklung). Dec 1972. 69p. (KFK-1593; EUR-4729). Dep. NTIS $5.50.

Work performed under United States–Euratom Fast Reactor Exchange Program.

Detection of disturbances in the cooling channels of a sodium cooled fast breeder requires the use of in-core instrumentation and processing the outcoming signals. The number of signals is large and the detection of the disturbance requires discrimination between temperature thresholds and operating temperatures which are a few degrees apart. The operating conditions of the sensing elements are so severe that a substantial percentage of detector failures has to be taken into account. The use of customary logical circuits does not allow separation of the deterministic character which must lead to the identification of a cooling disturbance from stochastic events like the decalibration of a thermocouple. These considerations have led to solution where a first step sorts the apparently disturbed subassemblies using a special grouping technique. The sorting operation involves a combination of signals which is not based on the classical use of logical functions, but on a more flexible method where different numerical weighting factors can be applied to include the safety criteria, the redundancy of the instrumentation, the credibility of the signal and the background of the detectors. The sorting process can be so fast that most of the cycle time is left to perform some detailed investigations on suspicious cases. These detailed investigations are divided according to their priority and use algorithms which are applied not on single values but on sequences of points. The process can formulate better diagnostics by verifying the steadiness of the signals, by classifying the critical profiles, and by checking the coincidence of such profiles. The application of the method is given for the fast breeder SNR 300 and shows that a reduction of the false scram signals could be achieved by using such a method. Methods of computing sciences and computing equipment are used. The hardware and software design are described. (auth)

26818 (GEAP-13923-1) SODIUM-COOLED REACTORS SAFETY ENGINEERING PROGRAM. First quarterly report, August–October 1972. (General Electric Co., Sunnyvale, Calif. Breeder Reactor Dept.). Nov 1972. Contract AT(04-3)-189. 16p. Dep. NTIS.

The Demonstration Plant will demonstrate the safe economical generation of electric power from a liquid metal cooled fast breeder reactor. Many aspects of the safety of such a plant have been under study for several years. The purpose of the project is: to bring into sharp focus both the requirements or needs for specific technical information related to safety, and the results of previous studies, wherever performed; and to recommend to AEC/RDT a course of action which will provide further needed information. The existing LMFBR activity concerning safety includes both analytical and experimental programs. A major requirement is the establishment of mechanisms for the guidance of the National Safety Program in the integration of these analytical and experimental programs. This guidance must establish specific objectives, priorities, and schedules for the programs, and it must provide a mechanism for identifying and correcting whatever problems that arise before they interfere with the schedule for the design and construction of the Demonstration Plant. Activity during August, September, and October 1972 is reported. (auth)

26819 (HEDL-SA-475) LIQUID METAL COOLED FAST REACTOR SAFETY. Peterson, R. E. (Hanford Engineering Development Lab., Richland, Wash.). [nd]. Contract AT(45-1)-2170. 23p. (CONF-721106-5). Dep. NTIS.

Liquid metal cooled fast reactors represent a new generation of reactors to which world commitment will be large because of their capability to conserve energy reserves through the breeding process. The Liquid Metal Cooled Fast Breeder Reactor is, therefore, of considerable interest from a safety viewpoint. Inherent design features are described which are shown to enhance the nuclear safety of these plants. Neutronics, coolant thermal and chemical properties, power density and other characteristics which differ from thermal reactors are discussed. Each of these characteristics is incorporated into the design such that no unique safety concerns need arise. Certain hypothetical events which are assumed to further demonstrate design margins against malfunctions is also considered. (auth)

26820 (JAERI-M-4806) VIBRATION OF REACTOR STRUCTURE, PART 2-6. VIBSES-6: Seismic Response Analysis Code. Ikushima, T. (Japan Atomic Energy Research Inst., Tokyo). May 1972. 27p. (In Japanese). NTIS (U. S. Sales Only).

The code VIBSES-6 analyzes the seismic response of reactor structures. The structure is treated as a multi-mass-points system. Features of the code are as follows: (1) the model of vibrations is in shear, bending, and their combination; (2) any seismic wave as input data can be treated; (3) numerical analysis is by the so-called Newmark-β, step-by-step integration; (4) the time intervals for calculation, graphic representation of results, and results printout can be chosen freely, so that a saving in computer time of the central processing unit is possible; the accuracy in calculation is still retained; and (5) subroutines for graphic representation are available to the code, so that results can be plotted with a CALCOMP plotting machine. The code is written in FORTRAN IV, and can be used with IBM 360 and FACOM 230-60. The calculation of seismic response is about 0.5 second per time step, for mass points fifteen. (auth)

26821 (JAERI-M-4937) ANALYSIS OF BLOWDOWN BEHAVIOR BY RELAP-2 CODE. Ohnishi, N.; Shimizu, S.; Ohota, K.; Mimura, M.; Kuwabara, S. (Japan Atomic Energy Research Inst., Tokyo). Aug 1972. 112p. (In Japanese). NTIS (U. S. Sales Only).

Experimental analysis results are presented for the code RELAP-2 which can analyze behavior of light-water-cooled power reactor during postulated accidents such as loss-of-coolant, pump failure, or power transients. Besides the experimental analysis, the code is described in detail including equations, input and output, and the analytical model. Experimental analyses of various semiscale blowdown systems have been made to demonstrate the predictive capability of the code for calculating the blowdown phenomena. These analytical results are presented and compared with data of calculation and experiment, including pressure, temperature and flow. In addition to the examination of the blowdown phenomena at a loss-of-coolant accident in light-water-cooled power reactors, postulated accident analyses were performed for pressurized and boiling water reactors, which reveals the problems and characteristics of the code. (auth)

26822 (JAERI-M-4956) ANALYSIS OF PRESSURE WAVE PROPAGATION IN PIPE RUPTURE ACCIDENTS OF LIGHT WATER COOLED REACTORS BY USE OF THE BURST CODE. II. Analysis of Blowdown Experiments and Application for Steam and/or Two-Phase Flow Systems. Shinoda, W.; Mitake, S.; Imaoka, T.; Aoki, H.; Kawabe, R. (Japan Atomic Energy Research Inst., Tokyo). Aug 1972. 46p. (In Japanese). NTIS (U. S. Sales Only).

Semiscale blowdown experiments were analyzed with the BURST Code to demonstrate its accuracy and to obtain information on operational techniques of the code. The results of two experiments which were carried out by Idaho Nuclear Corporation using a semiscale blowdown apparatus were compared with the predictions by BURST. Analytical results are in good agreement with experiment for a low temperature blowdown. For a higher temperature blowdown, the pressure variation at the exit nozzle influences the accuracy of the prediction, so that further investigations are necessary in order to establish the applicability of BURST to a higher temperature system. Pressure wave propagations through steam and two-phase flow were investigated by modifying a part of BURST. Calculations for the steam flow system yield encouraging results, whereas, too many difficulties are encountered in the analysis of two-phase flow depressurization, requiring basic understanding of the physical phenomena. (auth)

26823 (RD/B/N-2466) COMPILATION OF DATA FOR USE IN OFF SITE EMERGENCY CONTROL AT NUCLEAR POWER STATIONS. Macdonald, H. F.; Beynon, S. M. (Central Electricity Generating Board, Berkeley (England). Berkeley Nuclear Labs). Nov 1972. 52p. Dep. NTIS (U. S. Sales Only) $4.75.

The reactor safety analysis program WEERIE has been used to investigate the spatial distribution of doses resulting from a mixed fission product release for a typical reactor accident. Isopleths of inhaled dose and cloud-γ exposure have been produced using the graph plotting program PRUDE under a representative range of meteorological and release conditions. The effects of modifying factors such as radioactive decay or depletion of the plume due to ground deposition are also considered, and a tabulation of inhaled doses as a function of cloud concentration for a range of fission product nuclides is included. (auth)

26824 (RT/PROT-(72)19) SOME CONSIDERATIONS ON THE RELIABILITY FUNCTION OF A NUCLEAR PLANT WITH REFERENCE TO ITS SITE. Cagnetti, P.; Frittelli, L.; Nardi, A. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 1 Jul 1972. 23p. (CONF-700505-30). Dep. NTIS (U.S. Sales Only).

From 2nd Congress of the International Radiation Protection Association; Brighton, United Kingdom of Great Britain and Northern Ireland (UK) (3 May 1970).

The risk to which a population near the site of a nuclear installation is exposed following an accidental release can be assessed in terms of the probability, based on the reliability curve of the

installation (probability of occurrence of an accidental discharge as a function of its severity), the meteorological characteristics and population distribution of the site and the dose effect relationships generally accepted. Methods of calculation are proposed for determining in a quantitative way the best reliability curve for a nuclear installation in relation to the characteristics of the surrounding area and on the basis of a certain selected value for the level of acceptable risk. (auth)

26825 (WCAP-7705) ENGINEERED SAFEGUARDS FINAL DEVICE OR ACTUATOR TESTING. Haller, J. T. (Westinghouse Electric Corp., Pittsburgh, Pa.). May 1972. 47p. Dep. NTIS $4.00.

The extent of the on-the-line testing of the engineered safeguard systems in a typical PWR plant is described. Analog channel testing is performed at the analog instrumentation cabinets by individually introducing dummy input signals into the instrumentation channels and observing the tripping of the appropriate output bistables. The second phase consists of testing the logic and master relay circuits without actuating the slave relays. During the last phase of testing the slave relays are actuated to operate groups of the final devices, i.e., valves, pump motors, etc., wherever possible without causing plant upset. Devices that cannot be actuated while the plant is on-the-line because operation of these devices would result in a plant upset are tested only through to the operation of the respective output relay contact (output blocked) with a continuity check of the final device's actuator coil circuit. (auth)

26826 NUCLEAR POWER STATION. Isberg, G.; Pind, C. W.; Sundqvist, C. H. (to Allmanna Svenska Elektriska Aktiebolaget). U. S. Patent 3,712,851. 23 Jan 1973. Priority date 28 Mar 1968, Sweden. 14p.

A nuclear power station for location in heavily populated areas has a nuclear reactor which is surrounded by a conventional containment vessel. The containment vessel is located in a rock cavern forming a secondary containment and is supported from beneath and laterally by the floor and the walls of the rock cavern. The rock cavern is reinforced and made tight by injection of grout and a third containment is formed by the surrounding ground water which may be provided artificially. A pressure transmitting, missile protecting and non-leaktight shield is provided between the reactor and the primary containment so that the reactor is indirectly supported by the rock chamber walls. (Official Gazette)

26827 FLOATING REACTOR: CRISIS SOLUTION. Friedlander, G. D. IEEE (Inst. Elec. Electron. Eng.), Spectrum; 10: No. 2, 44-51(Feb 1973).

An overview is presented of the design, components in, and construction of off-shore nuclear power plants. Environmental and safety considerations are discussed. It is concluded that construction of such a facility is technically feasible, but the environmental and safety advantages need further evaluation. (LCL)

26828 DEVELOPMENT OF NUCLEAR ENERGY AND ENVIRONMENTAL SAFEGUARD IN THE ITALIAN LICENSING SYSTEM. Polvani, C.; Ilari, O. (CNEN, Rome). Com. Naz. Energ. Nucl., Notiz.; 18: No. 12, 39-41(Dec 1972). (In Italian).

Italian nuclear laws were issued between 1960 and 1964. The environmental protection aspects of these laws are illustrated. An improvement in environmental protection could be obtained by administrative planning and indication of areas in Italy which are suitable for reactor siting rather than administrative vetoing of proposed sites. (auth)

26829 SAFETY OF NUCLEAR POWER PLANTS: A PROBLEM OF SCIENTIFIC ANALYSIS OF ACCIDENTS. Adam, E.; Kuznetsov, V. (Technische Univ., Dresden). Kernenergie; 15: No. 11-12, 369-377(1972). (In German).

Safety technology of the pressurized water reactor serves for explanation of the emergency protection measures derived from safety considerations. Some studies on this problem carried out at the TU Dresden, Section of Energy Conversion, show how safety technology is being complied with continuous improvement according to nuclear power plant approach to the overcrowded regions. 16 references. (auth)

26830 PASSIVE NUCLEAR REACTOR SAFEGUARD SYSTEM. West, J. M.; Fletcher, W. D. (to Combustion Engineering, Inc.). U. S. Patent 3,718,539. 27 Feb 1973. Filed date 31 Mar 1971. 10p.

A safeguard system for a nuclear power plant is described that incorporates means for containing the emissions from a reactor accident to protect the environs of the plant against the release of harmful contaminants. The system includes a containment structure, housing the plant and a vapor suppression pool for condensing vaporous elements released from the plant. Various core cooling apparatus is integrated into the system to provide immediate and long term cooling of the reactor following a serious accident. (Official Gazette)

Steam and Power Conversion Systems

26831 (EURFNR-1069) STUDY OF THE POSSIBLE APPLICATION OF HEAT PIPES IN STEAM GENERATORS OF SODIUM-COOLED REACTORS. Hitschke, U. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Reaktorentwicklung). Dec 1972. 89p. (KFK-1664). Dep. NTIS $5.45.

Work performed under United States-Euratom Fast Reactor Exchange Program.

The thermal design and some investigations of various factors influencing the number and length of pipes and the utilization of the absolute maximum heat transfer capacity of the heat pipe are described. The results of these calculations are used to design a heat pipe steam generator. Finally the partial load behavior and, a particularly important point, the safety against sodium-water reactions are dealt with. The results indicate that no decisive advantages are apparent for the design. In the light of the present state of knowledge, the use of heat pipes in steam generators of sodium cooled reactors still seems to involve a number of problems. A final assessment will not be possible until there have been experimental studies of the operating behavior and the stability of heat pipes under steam generator conditions. (auth)

26832 (GULF-GA-A-12503) HTGR GAS TURBINE POWER PLANT CONTROL, SAFETY, AND MAINTENANCE STUDIES. Semiannual Progress Report for the Period July 1, 1972, through December 31, 1972. (Gulf General Atomic Co., San Diego, Calif.). 22 Feb 1973. Contract AT(04-3)-167. 194p. Dep. NTIS $12.00.

Results of control, safety, and maintenance studies for the high-temperature gas-cooled reactor (HTGR) gas turbine power plant are presented. Extensive steady-state and transient performance analyses are described, and two computer programs used to perform these analyses are documented. The performance results are discussed in terms of control system selection and a specific concept is recommended for further study. The safety aspects of the HTGR gas turbine plant were reviewed, and the results are discussed. Certain safety areas that require more extensive investigation are identified, and the influence of safety considerations on design alternatives is noted. Radioactivity levels in the primary circuit due to fission products and neutron activation have been estimated. The effect of these activity levels on maintenance operations and on lubricating oil are discussed. Design decisions of the HTGR gas turbine power plant are reported. (auth)

26833 PROCEDURE AND EQUIPMENT FOR STORING PEAK ENERGY FOR THE TURBINES OF ELECTRIC POWER PLANTS. Maillet, E. (to Commissariat a l'Energie Atomique). French Patent 95,867. 4 Oct 1971. Filed date 17 Jun 1968. 9p. (In French).

A procedure for producing electricity from the heat extracted from a CO_2 cooled nuclear reactor is presented. The procedure will improve the efficiency of reactors operating under normal and peak production conditions. The coolant gas is subjected to a thermodynamic cycle in which the gas is cooled; the heat given up by the gas during this cooling is used to heat a vaporizable liquid, which for peak production is subjected to a thermodynamic cycle with passage from the liquid to the vapor state. At least part of the vaporizable liquid heated by the coolant is retained under sufficient pressure to maintain it in the liquid state. During peak production this part is utilized by expanding it and producing evaporation. (FR)

26834 NUCLEAR REACTOR POWER PLANT. Hosegood, S. B. (to United Kingdom Atomic Energy Authority). British Patent 1,294,672. 1 Nov 1972. Filed date 6 Aug 1969. 6p.

In nuclear reactor power plants in which the reactor drives a power turbine it is usual to site the reactor alongside the turbo alternator sets in an adjacent building, or in some advanced concepts to incorporate the turbines in the same concrete structure as the reactor. This may be advantageous in some cases, but the system imposes certain restrictions on the disposition of the alternators and may not always constitute the best arrangement for particular requirements. In the arrangement described the turbine is housed in a pressure vessel separate from that housing the reactor, but interconnected by ducting for the supply of working fluid. Descriptions are included of complete power plants incorporating this arrangement. (UK)

26835 SECONDARY CYCLE CHEMISTRY CONTROL FOR A PRESSURIZED WATER REACTOR. Gabrielli, F.; Kurpen, J. J. (Combustion Engineering, Inc., Windsor, CT). Proc. Amer. Power Conf.; 34: 651-659(1972).

From 34th annual meeting of the American Power conference; Chicago, Illinois, USA (18 Apr 1972).
See CONF-720465-.

Commercial Power Reactors

Refer also to abstract 27115.

26836 (RT/EC-(72)-4) OPERATION OF NUCLEAR POWER PLANTS: STATISTICAL REMARKS. Maccazzola, F. (Comitato Nazionale per L'Energia Nucleare, Rome (Italy). Divisione Affari Internazionali E Studi Economici). 20 Dec 1972. 63p. (In Italian). Dep. NTIS (U. S. Sales Only) $5.25.

Listings, including statistics and performance, of world nuclear power plants, both installed and ordered, are given. (FS)

Physics and Core Engineering

26837 (AECL-4370) FREQUENCY RESPONSE MEASUREMENTS OF THE GENTILLY NUCLEAR REACTOR DYNAMICS. Serdula, K. J.; Kendall, J. D.; Cloutier, P. M.; Lawrence, C. B. (Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs). Jan 1973. 36p. (CONF-730108-5; SM-168-C-3). Dep. NTIS (U. S. Sales Only) $4.00. AECL $1.00.

From Symposium on nuclear power plant control and instrumentation; Prague, Czechoslovakia (22 Jan 1973).

The 250 MW (e) Gentilly Nuclear Power reactor is a departure from the CANDU Pressurized Heavy Water coolant series (CANDU-PHW's) in that its coolant is Boiling Light Water (CANDU-BLW). Retention of concepts of maximum neutron economy and natural uranium fueling have resulted in a system with a positive power coefficient. Because of this positive power coefficient and the prototypical nature of the station a comprehensive program was initially planned to derive the controlled and uncontrolled response of the neutron flux for both fundamental mode and first azimuthal or "tilt" mode reactivity perturbations. System dynamics were determined from measurements of the response of system parameters to applied perturbations. Experiments were initiated by a special computer program stored in the station controlling computer. In addition to controlling the reactivity perturbation, the special computer program also controlled parameters to be sampled and their sampling frequency, digital filtering of measured data, storage of data during experiments, and output of data after the experiment. Problems caused by the necessity to operate within limitations for normal station operation are discussed. The most restrictive constraint, caused by limited data storage capacity, resulted in aliasing problems and the need for digital filtering of data. Digitizing errors were a consideration for low power tests. During reactor commissioning responses of the neutron flux to fundamental mode and to first azimuthal mode reactivity perturbations were measured. Measured amplitude versus time data were analyzed off-line using a Fast Fourier Transform (FFT) algorithm to yield response functions and coherence functions. Individual values of the coherence function were used in an acceptance test for corresponding computed values of the response function. Response functions were then analyzed using a modal model and resultant transfer functions are shown for the zero power tests. These results agree with theoretical predictions. (auth)

26838 DEVELOPMENT OF NUCLEAR POWER PLANTS WITH WATER-MODERATED WATER-COOLED REACTORS IN THE SOVIET UNION. Denisov, V. P.; Markov, Yu. V.; Sidorenko, V. A.; Skvortsov, S. A.; Stekol'nikov, V. V.; Voronin, L. M. Kernenergie; 15: No. 11-12, 361-369(1972). (In German).

In Soviet nuclear power industry, nuclear power plants with water-moderated water-cooled reactors are widely used. A review is given of the developed 210, 365, 440, and 1000 MW(e) plants with water-moderated water-cooled power plants, particularly of the ways of further development, fundamental solutions of reactor equipment design, steam generators, main circulating pumps, main circulation lines, volume compensators, refuelling system, reconstruction of the WWER-210 reactor, as well as some results of investigations on the Novo-Voronezh nuclear power plant WWER-365 reactor core. 6 references. (auth)

26839 DESIGN OF 2300-MWe TWIN HIGH-TEMPERATURE GAS-COOLED REACTORS FOR PHILADELPHIA ELECTRIC. Gibbons, J. P. (Philadelphia Electric Co.); Waage, J. M.; Sieving, K. W. Proc. Amer. Power Conf.; 34: 195-206(1972).

From 34th annual meeting of the American power conference; Chicago, Illinois, USA (18 Apr 1972).
See CONF-720465-.

Control Elements, Systems, and Instrumentation

26840 (KFK-1593) PRINCIPLES AND FEASIBILITY OF A COMPUTER AIDED SAFETY CONTROL OF THE SNR CORE. Audoux, M. (Kernforschungszentrum, Karlsruhe (West Germany). Institut Fuer Reaktorentwicklung). Dec 1972. 60p. (In German). (EUR-4729). Dep. NTIS (U. S. Sales Only) $5.00.

26841 (WCAP-7913) PROCESS INSTRUMENTATION FOR WESTINGHOUSE NUCLEAR STEAM SUPPLY SYSTEMS (4 LOOP PLANTS USING WCID 7300 SERIES PROCESS INSTRUMENTATION). Reid, J. B. (Westinghouse Electric Corp., Pittsburgh, Pa.). Jan 1973. 105p.

Instruments and systems for the measurement, control, and recording of physical process phenomena associated with 4 loop pressurized water reactors, excluding nuclear and radiation measurements, are described. Safety related instrumentation is included. (JWR)

Containment Systems, Shielding, Waste Processing, and Radiation Protection

26842 (ASEA-ATOM-TI-2) REACTOR CONTAINMENT VESSEL. (ASEA-ATOM, Vasteras (Sweden)). Sep 1972. 14p. Dep. NTIS (U. S. Sales Only).

The ASEA-ATOM reactor containment is a water-pool, pressure-suppression containment vessel. This means that it encloses a large pool of water, in which the steam emerging from possible ruptures and leaks in the reactor primary system is condensed. In this way the pressure is kept lower than it would be otherwise. It is suppressed. The pool is located in the so-called wet well compartment of the containment vessel. The reactor and the remainder of the reactor primary system are located in the dry well compartment. The slipform cast prestressed concrete walls are less bulky but are expected to support penetrating pipes during accident conditions. A tight steel membrane is imbedded in the concrete. (SW)

26843 (GKSS-72/E/14) BRITTLE FAILURE OF IRRADIATED REACTOR PRESSURE VESSEL STEEL OF THE LINGEN NUCLEAR POWER PLANT IN THE FRAME OF TRACING ROUTINE. Schmitt, F. J.; Frisius, F.; Wille, P. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt m.b.H., Hamburg (West Germany)). 1972. 44p. (In German). Dep. NTIS (U. S. Sales Only).

Within the framework of the monitoring program for reactor pressure vessels, check-up studies were performed in the hot cells of the reactor center of the GKSS with irradiated notched-bar samples of the pressure vessel steel from the Lingen nuclear power plant. Simultaneously, the neutron doses were determined and correlated with the notched-bar samples. Diagrams and figures present the results and give a survey over the resilience changes of pressure vessel steel which may be expected to occur after long-term exposure to neutron radiation at the Lingen nuclear power plant. (HBG)

26844 SECONDARY CONTAINMENT DESIGN CONSIDERATIONS FOR NUCLEAR POWER STATIONS. Schwartztrauber, K. E.; Hauf, M. J. (Bechtel Corp., San Francisco). Proc. Amer. Power Conf.; 34: 228-237(1972).

From 34th annual meeting of the American Power conference; Chicago, Illinois, USA (18 Apr 1972).
See CONF-720465-.

Cooling Systems

Refer also to abstracts 25127 and 25183.

26845 (ASEA-ATOM-TI-3) INTERNAL MAIN CIRCULATION PUMPS. (ASEA-ATOM, Vasteras (Sweden)). Oct 1972. 20p. Dep. NTIS (U. S. Sales Only).

The pump motor is a submersed glandless squirrel cage induction motor. Variable frequency power to the pump motor is supplied from a static converter. Each pump has its own cooler to remove heat generated in the motor and heat transported to the motor case through heat conduction in the vessel nozzle and the pump shaft. The pump motors are mounted vertically below the reactor vessel. The motor case is welded to the reactor vessel itself. The pump shaft penetrates the vessel nozzle and the pump impeller is located in the annular space between the moderator vessel and the reactor vessel. All shaft bearings are located in low temperature regions in the motor case. The pump shaft runs through the hollow motor shaft and the two shafts are connected at the bottom of the motor. The impeller and pump shaft can be removed upwards with special handling equipment and the motor unit downwards without having to empty the reactor vessel of wa-

ter. The pump is tested in a rig and performance data are given. (auth)

26846 (COO-2244-1) STEAM–WATER MIXING TEST PROGRAM. Task D: Formal Report for Task A, 1/5 Scale Broken Loop. Lowe, P. A.; Brodrick, J. R.; Burchill, W. E. (Combustion Engineering, Inc., Windsor, Conn. Nuclear Power Dept.). Jan 1973. Contract AT(11-1)-2244. 103p. (CENPD-65). Dep. NTIS.

The test program and experimental results for steam and emergency core cooling water interaction in the broken cold leg piping of a pressurized water reactor are described. The program background and objectives are presented. The test apparatus and testing techniques are discussed. Raw data and engineering reduced data are presented in detail. (auth)

26847 FEEDWATER SYSTEM CHEMISTRY IN THE NINE MILE POINT BOILING-WATER REACTOR. Sawochka, S. G. (General Electric Co., San Jose, CA); Burns, R. A. Proc. Amer. Power Conf.; 34: 660-671(1972).

From 34th annual meeting of the American Power conference; Chicago, Illinois, USA (18 Apr 1972).

See CONF-720465–.

Fuel Systems and Components

26848 (AECL–4366) IMPROVED PERFORMANCE FOR UO_2 FUEL. Robertson, J.A.L. (Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs). Jan 1973. 9p. Dep. NTIS (U. S. Sales Only). AECL $0.50.

A program to monitor the performance of fuel in the Douglas Point Nuclear Generating Station revealed a small but significant increase in the fuel failure rate. Co-operation between the utility concerned (Ontario Hydro), Canadian fuel fabricators and AECL has resulted in fuel with improved performance being selected for commercial exploitation. The new fuel is already in production with the first bundles in service at the Pickering Nuclear Generating Station. (auth)

26849 (CEA-CONF-2114) INFLUENCE OF CREEP AND OF SWELLING UNDER IRRADIATION ON THE IN-PILE BEHAVIOR OF TUBULAR FUEL ELEMENTS OF A GRAPHITE–GAS CHANNEL. Blanchard, P.; Petit, M.; Blanchard, P. (Commissariat a l'Energie Atomique, Cadarache (France). Centre d'Etudes Nucleaires; Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). 25 Sep 1972. 22p. (In French). (CONF-721063-3). Dep. NTIS (U. S. Sales Only).

From Autumn Meeting on Metallurgy; Chatenay-Malabry, France (2 Oct 1972).

The deformation due to swelling and creep of four fuel alloys of CHINON-2 irradiated at the same time and the same specific burn-up are compared: $UMo_{1.1}$, $UMo_{1.1}Al_{0.1}$, $UMo_{1.1}Al_{0.2}$, and $UMo_{1.1}Al_{0.05}Sn_{0.05}$. The variations in the diameter and lateral swelling and the diameter and lateral creep parameters as a function of the position in the channel are presented for each alloy considered. These parameters are then considered individually for the four different alloys. (FR)

26850 (GU–5290) DRESDEN 1 PLUTONIUM RECYCLE PROGRAM. Semiannual Report for Period Ending December 31, 1972. Hamilton, G. (Gulf United Nuclear Fuels Corp., Elmsford, N. Y.). Jan 1973. Contract AT(11-1)-2210. 43p. Dep. NTIS $4.25.

Progress in the Dresden 1 plutonium recycle program during the semiannual period ending December 31, 1972 is reported. Information is presented on Cycle 8 operations, mixed-oxide assembly performance, and selection of plutonium fuel rods for post-irradiation examination. (JWR)

26851 (GU–5291) NUCLEAR DESIGN, ECONOMICS, AND SAFETY ANALYSIS OF THE DRESDEN 1 MIXED-OXIDE DEMONSTRATION ASSEMBLIES. Grochowski, G.; Hamilton, G.; Israel, S. (Gulf United Nuclear Fuels Corp., Elmsford, N. Y.). Dec 1972. Contract AT(11-1)-2210. 89p. Dep. NTIS $6.50.

The Dresden plutonium recycle demonstration program is described. Information is presented on nuclear design of the mixed-oxide assemblies, in-core fuel management, thermal-hydraulic design, safety considerations, economic analysis, and nuclear calculational methods for UO_2 and PuO_2–UO_2 fuel. (JWR)

26852 CNEN'S INTEGRATED LWR PLUTONIUM FUEL DESIGN AND FABRICATION CAPABILITIES. Schileo, G. C. (CNEN, Rome). Com. Naz. Energ. Nucl., Notiz.; 18: No. 12, 42-46(Dec 1972). (In Italian).

As part of the activities under CNEN's Plutonium Program, new and original solutions in the field of nuclear fuels have been devised, developed and tested. At the Casaccia Plutonium Plant, CNEN has fabricated full-scale plutonium fuel elements for a German concern, receiving a fee based on the quantity of thermal power generated. One of these elements has been in operation for more than one and a half years. (auth)

Operation and Economics

26853 (COO-3526-62) SAN ONOFRE NUCLEAR GENERATING STATION, SAN ONOFRE, CALIFORNIA. Operation Report for the Month of May 1972. (Southern California Edison Co., Los Angeles). 1972. Contract AT(11-1)-3526. 7p. Dep. NTIS $3.00.

26854 (DOCKET-50003–160) INDIAN POINT STATION, UNIT 1. Abnormal Occurrence Involving Average Flux Computer Reported December 29, 1972. (Consolidated Edison Co. of New York, Inc., New York). 22 Mar 1973. 3p. Dep. NTIS $3.00.

26855 (DOCKET-50010-141) DRESDEN NUCLEAR POWER STATION, UNIT 1. Error in Interpretation of Procedures. (Commonwealth Edison Co., Morris, Ill. (USA)). 20 Mar 1973. 4p. Dep. NTIS $3.00.

26856 (DOCKET-50010–143) DRESDEN NUCLEAR STATION, UNIT 1. Technical Specifications, Change 24. (Directorate of Licensing (AEC), Washington, D. C.). 14 Mar 1973. 3p. Dep. NTIS $3.00.

Revised technical specifications are presented concerning the maximum water temperature in the isolation condenser. (DCC)

26857 (DOCKET-50010–144) DRESDEN NUCLEAR STATION, UNIT 1. Effectiveness of Emergency Condenser in Terminating a Transient Was Reduced. (Commonwealth Edison Co., Chicago, Ill.). 27 Mar 1973. 2p. Dep. NTIS $3.00.

26858 (DOCKET-50016–182) ENRICO FERMI ATOMIC POWER PLANT, UNIT 1. Provisional Operating License DPR-9, Amendment 5. (Directorate of Licensing (AEC), Washington, D. C.). 29 Dec 1972. 3p. Dep. NTIS $3.00.

An extension of the operating license expiration date is presented. A revised maximum power level is included to provide for decay heat in the fuel with the reactor in the shutdown condition. (DCC)

26859 (DOCKET-50029–232) YANKEE NUCLEAR POWER STATION. AO-72-20, Radiator Hose Released. (Yankee Atomic Electric Co., Rowe, Mass.). 9 Jan 1973. 1p. Dep. NTIS $3.00.

26860 (DOCKET-50029–233) YANKEE NUCLEAR POWER STATION. Technical Specifications, Change 107. (Directorate of Licensing (AEC), Washington, D. C.). 14 Mar 1973. 3p. Dep. NTIS $3.00.

Revised technical specifications are presented concerning the rearrangement of fuel assemblies in Core 10. (DCC)

26861 (DOCKET-50029–235) YANKEE NUCLEAR POWER STATION. Variance in Pressurizer Code Safety Valve Set Pressures. (Yankee Atomic Electric Co., Rowe, Mass.). 27 Mar 1973. 2p. Dep. NTIS $3.00.

26862 (DOCKET-50133-115) HUMBOLDT BAY POWER PLANT, UNIT 3. Unplanned Release of Liquid Radwaste on January 26, 1973. (Pacific Gas and Electric Co., San Francisco, Calif.). 12 Mar 1973. 2p. Dep. NTIS $3.00.

26863 (DOCKET-50155-141) BIG ROCK POINT NUCLEAR PLANT. Fuel Assembly Operation with Cobalt Target Rods Removed. (Consumers Power Co., Jackson, Mich.). 28 Mar 1973. 6p. Dep. NTIS $3.00.

26864 (DOCKET-50155-142) BIG ROCK POINT NUCLEAR PLANT. Emergency Condenser Tube Bundle Leak. (Consumers Power Co., Jackson, Mich.). 23 Mar 1973. 2p. Dep. NTIS $3.00.

26865 (DOCKET-50155–143) BIG ROCK POINT NUCLEAR PLANT. Action to Be Taken to Correct Items of Apparent Noncompliance Brought to Attention Following Inspection of January 9–11, 1973. (Directorate of Regulatory Operations (AEC), Glen Ellyn, Ill. Region III). 16 Mar 1973. 14p. Dep. NTIS $3.00.

Information is presented concerning the operating requirements for the emergency steam condenser and leaks in the cooling system. (DCC)

26866 (DOCKET-50171-115) PEACH BOTTOM ATOMIC POWER STATION, UNIT 1. Storage and Shipment of Radioactive Fuel. (Directorate of Regulatory Operations (AEC), Washington, DC). 20 Mar 1973. 4p. Dep. NTIS $3.00.

26867 (DOCKET-50206-192) SAN ONOFRE NUCLEAR GENERATING STATION, UNIT 1. Broken Shaft on Fuel Injection

Pump to Diesel. (Southern California Edison Co., Rosemead, Calif.). 12 Mar 1973. 2p. Dep. NTIS $3.00.

26868 (DOCKET-50213-184) HADDAM NECK PLANT, UNIT 1. Operation Report 73-2, February 1973. (Connecticut Yankee Atomic Power Co., East Hampton (USA)). 26 Mar 1973. 17p. (NYO-3144-81). Dep. NTIS $3.00.

26869 (DOCKET-50220-129) NINE MILE POINT NUCLEAR STATION, UNIT 1. Permission to Use Type 4 Gadolina Bearing Fuel. (Directorate of Licensing (AEC), Washington, D. C.). 4 Apr 1973. 1p. Dep. NTIS $3.00.

26870 (DOCKET-50237-307) DRESDEN NUCLEAR POWER STATION, UNIT 2. High Above Ground Activity at "C" Waste Sample Tank. (Commonwealth Edison Co., Morris, Ill. (USA)). 22 Mar 1973. 2p. Dep. NTIS $3.00.

26871 (DOCKET-50237-308) DRESDEN NUCLEAR POWER STATION, UNIT 2. Valve Malfunction on February 22, 1973 and February 23, 1973. (Commonwealth Edison Co., Chicago, Ill.). 23 Mar 1973. 4p. Dep. NTIS $3.00.

26872 (DOCKET-50237-309) DRESDEN NUCLEAR POWER STATION, UNIT 2. Differential Pressure Switch Inoperable on Test. (Commonwealth Edison Co., Chicago, Ill.). 19 Mar 1973. 3p. Dep. NTIS $3.00.

26873 (DOCKET-50237-310) DRESDEN NUCLEAR POWER STATION, Units 2 AND 3. Special Report 18, Dresden Units 2 and 3 Safety Valve Investigations, Supplement A. (Commonwealth Edison Co., Chicago, ILL). 26 Mar 1973. 25p. (DOCKET-50249-200). Dept. NTIS $3.25.

26874 (DOCKET-50237-311) DRESDEN NUCLEAR POWER STATION, UNITS 2 AND 3. Radwaste Above Ground Storage in Excess of Technical Specifications Limit. (Commonwealth Edison Co., Chicago, Ill.). 30 Mar 1973. 2p. (DOCKET-50249-201). Dep. NTIS $3.00.

26875 (DOCKET-50244-149) ROBERT EMMETT GINNA NUCLEAR POWER PLANT, UNIT 1. Monthly Report of Activity Measurements, February 1-28, 1973. (Rochester Gas and Electric Corp., N. Y.). 22 Mar 1973. 2p. Dep. NTIS $3.00.

26876 (DOCKET-50245-200) MILLSTONE NUCLEAR POWER STATION, UNIT 1. Abnormal Occurrence AO-73-2, Failure of Gas Turbine to Start, March 14, 1973. 15 Mar 1973. 4p. Dep. NTIS $3.00.

26877 (DOCKET-50249-196) DRESDEN NUCLEAR POWER STATION, UNIT 3. Standby Liquid Control System Declared Inoperable, January 3, 1973. (Commonwealth Edison Co., Chicago, Ill.). 9 Jan 1973. 2p. Dep. NTIS $3.00.

26878 (DOCKET-50249-197) DRESDEN NUCLEAR POWER STATION, UNIT 3. Gas Monitor Out of Calibration, October 20, 1972; HPCI System Inoperable, November 6, 1972; High Steam Flow Isolation Sensors Out of Calibration, January 9, 1973; Level Switch on LPCI System Out of Calibration, January 1, 1973. (Commonwealth Edison Co., Morris, Ill. (USA)). 10 Jan 1973. 4p. Dep. NTIS $3.00.

26879 (DOCKET-50249-198) DRESDEN NUCLEAR POWER STATION, UNIT 3. HPCI Room Temperature Switches Out of Calibration. (Commonwealth Edison Co., Morris, Ill. (USA)). 19 Mar 1973. 2p. Dep. NTIS $3.00.

26880 (DOCKET-50249-199) DRESDEN NUCLEAR POWER STATION, UNIT 3. Excessive Radioactivity in Radwaste Storage Tanks. (Commonwealth Edison Co., Morris, Ill. (USA)). 20 Mar 1973. 2p. Dep. NTIS $3.00.

26881 (DOCKET-50249-202) DRESDEN NUCLEAR POWER STATION, UNIT 3. Barton Differential Pressure Switch Found Damaged. (Commonwealth Edison Co., Chicago, ILL). 30 Mar 1973. 2p. Dep. NTIS $3.00.

26882 (DOCKET-50249-203) DRESDEN NUCLEAR POWER STATION, UNIT 3. Main Steam Line Area Temperature Switches Out of Calibration March 24, 1973. (Commonwealth Edison Co., Morris, Ill. (USA)). 30 Mar 1973. 2p. Dep. NTIS $3.00.

26883 (DOCKET-50250-116) TURKEY POINT STATION, UNIT 3. Abnormal Occurrences 3-73-2, Component Cooling Water Pump Failed to Start on Signal March 9, 1973. Abnormal Occurrence 3-73-3, Diesel Generator Failed to Start on March 10, 1973. (Florida Power and Light Co.). 19 Mar 1973. 3p. Dep. NTIS $3.00.

26884 (DOCKET-50254-175) QUAD-CITIES STATION, UNITS 1 AND 2. Chlorine Residual Concentration in Excess of Limiting Condition. (Commonwealth Edison Co., Cordova, Ill.). 12 Mar 1973. 2p. (DOCKET-50265-166). Dep. NTIS $3.00.

26885 (DOCKET-50254-176) QUAD-CITIES STATION, UNITS 1 AND 2. Completion of Startup Program. (Commonwealth Edison Co., Chicago, Ill.). 21 Mar 1973. 1p. (DOCKET-50265-167). Dep. NTIS $3.00.

26886 (DOCKET-50254-179) QUAD-CITIES STATION, UNITS 1 AND 2. Minor unplanned release. (Commonwealth Edison Co., Cordova, Ill.). 30 Mar 1973. 2p. (DOCKET-50265-169). Dep. NTIS $3.00.

26887 (DOCKET-50255-145) PALISADES PLANT. Permission to Startup Plant in Prescribed Manner. (Consumers Power Co., Jackson, Mich.). 21 Dec 1972. 2p. Dep. NTIS $3.00.

26888 (DOCKET-50261-151) H. B. ROBINSON UNIT 2. Steps Taken to Correct Items of Noncompliance Brought to Attention Following Inspection, October 3-6, 1972. (Carolina Power and Light Co., Raleigh, N. C.). 9 Feb 1973. 17p. Dep. NTIS $3.25.
Requested information is presented concerning the boric acid tank level instrumentation bubbler tubes. (DCC)

26889 (DOCKET-50261-152) H. B. ROBINSON UNIT 2. Technical Specifications, Request for Revision, Surveillance of Charcoal and HEPA Filters. (Carolina Power and Light Co., Raleigh, N. C.). 23 Mar 1973. 2p. Dep. NTIS $3.00.

26890 (DOCKET-50261-154) H. B. ROBINSON UNIT 2. Technical Specifications, Request for Temporary Revision, Surveillance of Charcoal and HEPA Filters. (Carolina Power and Light Co., Raleigh, N. C.). 2 Apr 1973. 2p. Dep. NTIS $3.00.

26891 (DOCKET-50261-157) H. B. ROBINSON UNIT 2. Technical Specifications, Change 13. (Directorate of Licensing (AEC), Washington, D. C.). 14 Mar 1973. 8p. Dep. NTIS $3.00.
Revised technical specifications are presented concerning the handling of irradiated fuel elements in the spent fuel building. (DCC)

26892 (DOCKET-50261-158) H. B. ROBINSON UNIT 2. Technical Specifications, Change 14. (Directorate of Licensing (AEC), Washington, D. C.). 28 Mar 1973. 4p. Dep. NTIS $3.00.
Revised specifications are presented concerning the inspection requirements for boron concentration in the boron injection tank. (DCC)

26893 (DOCKET-50261-159) H. B. ROBINSON UNIT 2. Technical Specifications, Change 15. (Directorate of Licensing (AEC), Washington, D. C.). 27 Mar 1973. 7p. Dep. NTIS $3.00.
Revised technical specifications are presented concerning the testing procedures for containment system filters. (DCC)

26894 (DOCKET-50263-192) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. Violation of Primary Containment. (Northern States Power Co., Minneapolis, Minn.). 12 Mar 1973. 1p. Dep. NTIS $3.00.

26895 (DOCKET-50263-193) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. Main Steam Tunnel High Area Temperature Switch Set Point Deviation. (Northern States Power Co., Minneapolis, Minn.). 19 Mar 1973. 1p. Dep. NTIS $3.00.

26896 (DOCKET-50263-195) MONTICELLO NUCLEAR GENERATING PLANT, UNIT 1. Authorization to Operate with Reload 1 Fuel Bundles in the Core. (Directorate of Licensing (AEC), Washington, D. C.). 5 Mar 1973. 2p. Dep. NTIS $3.00.

26897 (DOCKET-50265-170) QUAD-CITIES STATION, UNIT 2. 3 of 4 EHC Oil Pressure Switches out of Calibration. Due to Valving Error Torus Water Level Raised Above 2 Inch Limit. (Commonwealth Edison Co., Cordova, Ill.). 21 Dec 1972. 3p. Dep. NTIS $3.00.

26898 (DOCKET-50266-105) POINT BEACH NUCLEAR PLANT, UNIT 1. Unmonitored Letdown Line. (Wisconsin Electric Power Co., Milwaukee). 15 Mar 1973. 2p. Dep. NTIS $3.00.

26899 (DOCKET-50267-52) FORT ST. VRAIN NUCLEAR GENERATING STATION. Control and Orificing Assemblies. (Public Service Co. of Colorado, Denver). 18 Jan 1973. 13p. Dep. NTIS.

26900 (DOCKET-50267-56) FORT ST. VRAIN NUCLEAR GENERATING STATION. PCRV Cooling Water System. (Public Service Co. of Colorado, Denver). 26 Mar 1973. 4p. Dep. NTIS $3.00.

Information is presented concerning tube leaks in a heat exchanger of the prestressed concrete reactor vessel cooling water system. (DCC)

26901 (DOCKET-50269-88) OCONEE NUCLEAR STATION, UNIT 1. Operating License DPR-38 with Technical Specifications. 6 Feb 1973. 212p. Dep. NTIS.

26902 (DOCKET-50269-95) OCONEE NUCLEAR STATION, UNITS 1, 2, AND 3. Control Rod Drive Breaker Undervoltage Trip Assembly. (Duke Power Co., Charlotte, NC). 23 Feb 1973. 9p. (DOCKET-50270-78; DOCKET-50287-70). Dep. NTIS $3.00.

26903 (DOCKET-50271-156) VERMONT YANKEE NUCLEAR POWER STATION. Inadequacy in Implementation of Administrative Controls. (Vermont Yankee Nuclear Power Corp., Rutland). 9 Mar 1973. 2p. Dep. NTIS $3.00.

26904 (DOCKET-50280-112) SURRY POWER STATION, UNIT 1. AO-S1-73-02, Failure of Overload Protection Relay (OD-6). (Virginia Electric and Power Co., Richmond). 22 Mar 1973. 5p. Dep. NTIS $3.00.

26905 (DOCKET-50280-114) SURRY POWER STATION, UNITS 1 AND 2. Technical Specification Change No. 6, Request Reconsideration. (Virginia Electric and Power Co., Richmond). 3 Apr 1973. 2p. (DOCKET-50281-91). Dep. NTIS $3.00.

A request is presented for reconsideration of in-core monitoring requirements for power levels of 88% rated power or higher. (DCC)

26906 (DOCKET-50280-115) SURRY POWER STATION, UNITS 1 AND 2. Technical Specifications, Proposed Changes. (Virginia Electric and Power Co., Richmond). 20 Mar 1973. 4p. (DOCKET-50281-93). Dep. NTIS $3.00.

Revised technical specifications are presented concerning test requirements for the refueling water storage tank outlet valves. (DCC)

26907 (DOCKET-50281-92) SURRY POWER STATION, UNIT 2. A0-S2-73-02, Emergency Diesel Generator No. 2 Failure. (Virginia Electric and Power Co., Richmond). 23 Mar 1973. 6p. Dep. NTIS $3.00.

26908 (DOCKET-50282-98) PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNITS 1 AND 2. Interim Report on Diesel Generator Scavenging Air Blower. (Northern States Power Co., Minneapolis, Minn.). 2 Mar 1973. 3p. (DOCKET-50306-93). Dep. NTIS $3.00.

26909 (DOCKET-50293-124) PILGRIM NUCLEAR POWER STATION. Deletion of Full Power Turbine Stop Valve Closure Test. (Boston Edison Co., Mass.). 14 Mar 1973. 2p. Dep. NTIS $3.00.

26910 (DOCKET-50293-126) PILGRIM NUCLEAR POWER STATION. Abnormal Occurrence AO-73-9, Main Stack Monitoring System; Abnormal Occurrence AO-73-10, Barton Model 288 Differential Pressure Indicating Switch, March 25, 1973. (Boston Edison Co., Mass.). 15 Mar 1973. 2p. Dep. NTIS $3.00.

26911 (DOCKET-50293-127) PILGRIM NUCLEAR POWER STATION. Tests of Vacuum Breaker Performance. (Boston Edison Co., Mass.). 26 Mar 1973. 26p. Dep. NTIS $3.50.

26912 (DOCKET-50301-88) POINT BEACH NUCLEAR PLANT, UNIT 2. Notice of Issuance of Amendment 3 to Facility Operating License. Facility Operating License DPR 27, Changes Nos. 3 and 6 to Technical Specifications and Appendix vs. Experimental Technical Specifications. (Directorate of Licensing (AEC), Washington, D.C.). 8 Mar 1973. 59p. Dep. NTIS.

26913 (DOCKET-50301-90) POINT BEACH NUCLEAR PLANT, UNIT 2. Unscheduled Release of Radioactivity. (Wisconsin Electric Power Co., Milwaukee). 22 Mar 1973. 3p. Dep. NTIS $3.00.

26914 (DOCKET-50301-91) POINT BEACH NUCLEAR POWER PLANT, UNIT 2. Exceeding of Hot Channel Factor Limits. (Wisconsin Electric Power Co., Milwaukee). 23 Mar 1973. 4p. Dep. NTIS $3.00.

26915 (DOCKET-50309-98) MAINE YANKEE ATOMIC POWER STATION. Monthly Report 1-73, January 1973. (Maine Yankee Atomic Power Co., Westboro, Mass.). 12 Mar 1973. 26p. Dep. NTIS $3.50.

26916 (DOCKET-50348-54) JOSEPH M. FARLEY NUCLEAR PLANT, UNITS 1 AND 2. Damage to Power and Control Cables. (Alabama Power Co., Birmingham). 26 Mar 1973. 5p. (DOCKET-50364-46). Dep. NTIS $3.00.

26917 (TID-26278) 1972 ATOMIC ENERGY PROGRAMS: REGULATORY ACTIVITIES. (Atomic Energy Commission, Washington, DC). 1973. 59p. Dep. GPO $0.90.

The annual report to Congress on the regulatory activities of the AEC in 1972 is presented. Separate chapters are included which cover reactor licensing and other regulatory activities, licensing of nuclear facilities in 1972, public participation in licensing, regulating nuclear operations, and development of regulatory standards. (JWR)

26918 GE'S NEW BWR 6 WITH MARK III CONTAINMENT. Com. Naz. Energ. Nucl., Notiz.; 18: No. 12, 76-78(Dec 1972). (In Italian).

Described is the new type of BWR 6 reactor which General Electric has recently placed on the market and several of which have already been sold. (auth)

26919 PROBLEMS CONCERNING OPTIMUM AVAILABILITY OF THE RHEINSBERG NUCLEAR POWER PLANT. Brune, W. (VEB Kernkraftwerke, Rheinsberg, Ger.). Kernenergie; 15: No. 11-12, 377-380(1972). (In German).

During its first years of operation the Rheinsberg nuclear power plant was operated with a comparatively high portion of regular shutdown days for maintenance works in order to gain sufficient operating experience. Today, after more than 5 years of operation, optimization of maintenance shutdown planning and, consequently, of availability is necessitated. On the basis of perturbation analysis, reflections on optimization of operating strategy for the Rheinsberg nuclear power plant are presented, and practical conclusions concerning planning are made. 9 references. (auth)

26920 NUCLEAR TECHNOLOGY: TIME FOR A BREATHER. Smock, R. W. Elec. Light Power (Boston); 51: No. 3, 25-28(Feb 1973).

The reasons why improved performance of light water reactors has become less important to U. S. utility companies than improved safety, licensability, refueling speed, reliability, and maintainability are discussed. (LCL)

26921 PROPOSED STANDARD FOR INDUSTRIAL SECURITY FOR NUCLEAR POWER PLANTS. ANS-3.3-1972. Hinsdale, IL; American Nuclear Society (1972). 26p.

Criteria for industrial security programs to protect operational nuclear power plants from acts of sabotage which could lead to a threat to public health and safety are presented. Important aspects of security planning which are discussed individually include designated security areas, administrative controls, and plant design. (JWR)

26922 ADMINISTRATIVE CONTROLS FOR NUCLEAR POWER PLANTS. ANSI N18.7-1972. New York; American National Standard Institute (1972). 17p.

Criteria for the administrative controls necessary for the safe and efficient operation of nuclear power plants are presented. (JWR)

Safety and Siting

26923 (ARMS-70.6.3) AERIAL RADIOLOGICAL MEASURING SYSTEM. Dresden Nuclear Power Station, July 1970. (EG and G, Inc., Las Vegas, Nev.). Jan 1973. 26p. (EGG-1183-1545). Dep. NTIS.

The Aerial Radiological Measuring System (ARMS) was used to perform an aerial radiological survey of the Dresden Nuclear Power Station and surrounding area during July 1970. The survey included terrestrial background gamma radiation and a plume track of the stack release gases. A high-sensitivity detection system collected gamma-ray spectral and gross-count data. The data were then computer processed into an isoexposure contour map, 3 feet above the ground, of a 200 square mile area and a plume track map. Results indicated the presence of isotopes normally found in the background radiation throughout the United States. The plume track revealed fission product-related noble gases consistent with normal plant operations. (auth)

26924 (DOCKET-50003-157) INDIAN POINT STATION, UNIT 1. Technical Specifications, Change Request. (Consolidated Edison Co. of New York, Inc., New York). 19 Mar 1973. 9p. Dep. NTIS $3.00.

Revised technical specifications are presented concerning administrative controls for operation. (DCC)

26925 (DOCKET-50003-158) INDIAN POINT STATION, UNIT 1. Meteorology. (New York Univ., N. Y. School of Engineering and Science). 16 Mar 1973. 100p. Dep. NTIS $3.00.

For Consolidated Edison Co. of New York, Inc., New York.

26926 (DOCKET-50003-159) INDIAN POINT STATION, UNIT 1. Fuel Densification Effects. (Consolidated Edison Co. of New York, Inc., New York). 4 Apr 1973. 50p. (WCAP-8081). Dep. NTIS $4.50.

26927 (DOCKET-50010-142) DRESDEN NUCLEAR STATION, UNIT 1. Special Report 20, Dresden Unit 1 Safety Valve Stress Analysis. (Commonwealth Edison Co., Chicago, Ill.). 21 Mar 1973. 20p. Dep. NTIS $3.00.

26928 (DOCKET-50016-183) ENRICO FERMI ATOMIC POWER PLANT, UNIT 1. Technical Specifications, Change 33. (Directorate of Licensing (AEC), Washington, D. C.). 26 Jan 1973. 3p. Dep. NTIS $3.00.

Revised technical specifications are presented for dollar subcritical requirements during fuel element unloading procedures. (DCC)

26929 (DOCKET-50016-184) ENRICO FERMI ATOMIC POWER PLANT, UNIT 1. Technical Specifications, Change 34. (Directorate of Licensing (AEC), Washington, D. C.). 12 Mar 1973. 13p. Dep. NTIS $3.00.

Revised technical specifications are presented concerning the cooling system, emergency core cooling system, control system, radioactive waste disposal system, electric power system, auxiliary systems, and personnel. (DCC)

26930 (DOCKET-50029-230) YANKEE NUCLEAR POWER STATION. Wall Thickness of Nuclear Service Valves. (Yankee Atomic Electric Co., Westboro, Mass.). 7 Mar 1973. 5p. Dep. NTIS $3.00.

26931 (DOCKET-50029-231) YANKEE NUCLEAR POWER STATION. Fuel Densification Effects, Correction. (Yankee Atomic Electric Co., Westboro, Mass.). 19 Mar 1973. 1p. Dep. NTIS $3.00.

26932 (DOCKET-50029-234) YANKEE NUCLEAR POWER STATION. 1972 Financial Statements and Summary of Financial Protection. (Yankee Atomic Electric Co., Westboro, Mass.). 20 Mar 1973. 5p. Dep. NTIS $3.00.

26933 (DOCKET-50130-16) PATHFINDER GENERATING PLANT. Provisional Operating License Termination. (Northern States Power Co., Minneapolis, Minn.). 16 Mar 1973. 2p. Dep. NTIS $3.00.

26934 (DOCKET-50171-116) PEACH BOTTOM ATOMIC POWER STATION, UNIT 1. Certification by Commonwealth of Pennsylvania, Department of Environmental Resources. (Philadelphia Electric Co., Pa.). 6 Apr 1973. 6p. Dep. NTIS $3.00.

26935 (DOCKET-50213-182) HADDAM NECK PLANT, UNIT 1. Draft Environmental Statement. (Directorate of Licensing (AEC), Washington, D. C.). Mar 1973. 233p. Dep. NTIS $13.75.

The environmental effects of construction and operation of the Connecticut Yankee Power Reactor are examined. The descriptions include: (1) the environment in the area, including the history, geography and geology, hydrology, climatology, ecology, land and water use including chemical characteristics, (2) the facility and its effluents, (3) the impacts from construction and operation of the unit, (4) alternatives to the proposed action, (5) irreversible and irretrievable long-term commitments of resources from plant operation, (6) need for power, and (7) the benefits-cost analysis of the proposed plant operation. (auth)

26936 (DOCKET-50213-183) HADDAM NECK PLANT, UNIT 1. Technical Specifications, Proposed Change No. 22. (Connecticut Yankee Atomic Power Co., Hartford). 30 Mar 1973. 2p. Dep. NTIS $3.00.

Revised technical specifications are presented concerning the post accident venting of hydrogen from the containment structure. (DCC)

26937 (DOCKET-50219-241) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Operating Quality Assurance Plan. (Jersey Central Power and Light Co., Morristown, N. J.). 15 Mar 1973. 33p. Dep. NTIS $3.75.

26938 (DOCKET-50219-242) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Fish Mortalities. (Jersey Central Power and Light Co., Morristown, N. J.). 14 Feb 1973. 14p. Dep. NTIS $3.00.

26939 (DOCKET-50219-243) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Provisional Operating License No. DPR 16, Amendment 72. (Jersey Central Power and Light Co., Morristown, N. J.). 4 Apr 1973. 4p. Dep. NTIS $3.00.

Revised technical specifications are presented concerning the possession limits for ^{239}Pu and ^{241}Pu. (DCC)

26940 (DOCKET-50219-244) OYSTER CREEK NUCLEAR POWER PLANT, UNIT 1. Facility Change Request No. 4, Supplement 2. (Jersey Central Power and Light Co., Morristown, N. J.). 4 Apr 1973. 42p. Dep. NTIS $4.50.

Revised technical specifications are presented concerning the use of Type 4 Zircaloy 2 clad PuO_2-UO_2 fuel assemblies. (DCC)

26941 (DOCKET-50220-127) NINE MILE POINT NUCLEAR STATION, UNIT 1. Drywell Vacuum Breakers. (Niagara Mohawk Power Corp., Syracuse, N. Y.). 23 Mar 1973. 26p. Dep. NTIS $3.50.

26942 (DOCKET-50237-312) DRESDEN NUCLEAR POWER STATION, UNITS 2 AND 3. Torus Baffle Studies. (Commonwealth Edison Co., Chicago, Ill.). 26 Mar 1973. 2p. (DOCKET-50249-204). Dep. NTIS $3.00.

26943 (DOCKET-50244-143) ROBERT EMMETT GINNA NUCLEAR POWER PLANT, UNIT 1. Comment Regarding RO Inspection Report 50-244/72-08. (Rochester Gas and Electric Corp., N. Y.). 9 Feb 1973. 3p. Dep. NTIS.

Additional information on pipe vibrations and installation of pipe supports at the Robert E. Ginna Power Plant, Unit 1 is provided. (JWR)

26944 (DOCKET-50244-150) ROBERT EMMETT GINNA NUCLEAR POWER PLANT, UNIT 1. Final Safety Analysis Report, Supplement 15. (Rochester Gas and Electric Corp., N. Y.). 23 Mar 1973. 25p. Dep. NTIS $3.25.

Requested information on the quality assurance program for the Robert E. Ginna Power Reactor, Unit 1 is presented. (JWR)

26945 (DOCKET-50245-201) MILLSTONE NUCLEAR POWER STATION, UNIT 1. Technical Specifications, Proposed Change. (Millstone Point Co., Hartford, Conn.). 20 Mar 1973. 3p. Dep. NTIS $3.00.

Revised technical specifications are presented concerning the boron concentration for the standby liquid control system. (DCC)

26946 (DOCKET-50250-117) TURKEY POINT PLANT, UNITS 3 AND 4. Final Safety Analysis Report, Supplement 56. (Florida Power and Light Co.). 30 Mar 1973. 236p. (Docket-50251-98). Dep. NTIS $14.00.

Revised and additional data are presented concerning safety analysis, personnel qualifications, radioactive waste disposal, power conversion system, auxiliary systems, control system, engineered safeguards, and site. (DCC)

26947 (DOCKET-50250-119) TURKEY POINT PLANT, UNITS 3 AND 4. Technical Specifications, Proposed Changes. (Florida Power and Light Co.). 30 Mar 1973. 10p. (Docket-50251-99). Dep. NTIS $3.00.

Revised technical specifications are presented concerning in-service inspection requirements. (DCC)

26948 (DOCKET-50254-177) QUAD-CITIES STATION, UNITS 1 AND 2. Composition of Ventilation Stack Effluent. (Commonwealth Edison Co., Cordova, ILL). 29 Mar 1973. 3p. (DOCKET-50265-168). Dep. NTIS $3.00.

26949 (DOCKET-50254-178) QUAD-CITIES STATION, UNIT 1. Mutual Atomic Energy Liability Underwriters Policy No. MF-54, Endorsements Nos. 25 and 26. (Commonwealth Edison Co., Chicago, Ill.). 30 Mar 1973. 3p. Dep. NTIS $3.00.

26950 (DOCKET-50255-142) PALISADES PLANT. Interim Special Technical Specifications (Appendix B), Change 5. (Directorate of Licensing (AEC), Washington, D. C.). 23 Mar 1973. 28p. Dep. NTIS $3.50.

Revised technical specifications are presented concerning reactor operating limits of 2200 MW(t) for a period covering 6000 MWD/MTU. (DCC)

26951 (DOCKET-50255-143) PALISADES PLANT. Tendon Surveillance. (Consumers Power Co., Jackson, Mich.). 8 Aug 1972. 1p. Dep. NTIS $3.00.

26952 (DOCKET-50255-144) PALISADES PLANT. Main Steam Safety Valve. (Directorate of Regulatory Operations (AEC), Glen Ellyn, Ill. Region III). 22 Sep 1972. 2p. Dep. NTIS $3.00.

26953 (DOCKET-50255-146) PALISADES PLANT. Loss of Coolant Accident, Additional Information. (Consumers Power Co., Jackson, Mich.). 20 Mar 1973. 2p. Dep. NTIS $3.00.

26954 (DOCKET-50255-147) PALISADES PLANT. Clarification of Letter of March 20, 1973. (Consumers Power Co., Jackson, Mich.). 4 Apr 1973. 2p. Dep. NTIS $3.00.

Additional information is presented concerning the core linear heat generation rate. (DCC)

26955 (DOCKET-50255-148) PALISADES PLANT. Request Changes to Figure B-1 of Appendix B to Operating License. (Consumers Power Co., Jackson, Mich.). 4 Apr 1973. 1p. Dep. NTIS $3.00.
Revised information is presented concerning the linear heat generation rate. (DCC)

26956 (DOCKET-50255-149) PALISADES PLANT. Technical Specifications, Change 6. (Directorate of Licensing (AEC), Washington, D. C.). 5 Apr 1973. 3p. Dep. NTIS $3.00.
Revised technical specifications are presented concerning the linear heat generation rate. (DCC)

26957 (DOCKET-50261-153) H. B. ROBINSON UNIT 2. Monthly Report of Primary and Secondary Activity Measurements and Effluent Discharge Activity Levels. (Carolina Power and Light Co., Raleigh, N. C.). 15 Mar 1973. 2p. Dep. NTIS $3.00.

26958 (DOCKET-50261-155) H. B. ROBINSON UNIT 2. Technical Specifications, Request for Revision. (Carolina Power and Light Co., Raleigh, NC). 2 Apr 1973. 3p. Dep. NTIS $3.00.
Revised technical specifications are presented concerning the containment structure, auxiliary systems, and radiation protection. (DCC)

26959 (DOCKET-50261-156) H. B. ROBINSON UNIT 2. Technical Specifications, Temporary Change Request. (Carolina Power and Light Co., Hartsville, S. C. (USA)). 31 Mar 1973. 2p. Dep. NTIS $3.00.
Revised technical specifications are presented concerning the efficiencies of containment system filters during fuel shuffling operations. (DCC)

26960 (DOCKET-50269-96) OCONEE NUCLEAR STATION, UNIT 1. Inspection Report 73-1. (Directorate of Regulatory Operations (AEC), Atlanta, Ga. (USA). Region II). 15 Mar 1973. 75p. Dep. NTIS $5.75.

26961 (DOCKET-50271-157) VERMONT YANKEE NUCLEAR POWER STATION. Plant Stack Filter Not Counted Week January 22-28, 1973. (Vermont Yankee Nuclear Power Corp., Rutland). 22 Mar 1973. 1p. Dep. NTIS $3.00.

26962 (DOCKET-50271-158) VERMONT YANKEE NUCLEAR POWER STATION. Potential Malfunctions of Drywell Vacuum Breakers. (Vermont Yankee Nuclear Power Corp., Rutland). 28 Mar 1973. 12p. Dep. NTIS $3.00.

26963 (DOCKET-50272-53) SALEM NUCLEAR GENERATING STATION, UNITS 1 AND 2. Draft Environmental Statement, Additional Responses to Comment From Federal, State, and Local Agencies. (Public Service Electric and Gas Co., Newark, N. J.). 3 Apr 1973. 15p. (DOCKET-50311-54). Dep. NTIS $3.00.

26964 (DOCKET-50275-34) DIABLO CANYON NUCLEAR POWER PLANT, UNIT 1. Inspection of August 9-11, 1972. (Directorate of Regulatory Operations (AEC), Berkeley, Calif. (USA). Region V). 23 Aug 1972. 3p. Dep. NTIS $3.00.

26965 (DOCKET-50277-78) PEACH BOTTOM ATOMIC POWER STATION, UNITS 2 AND 3. Review of All Safety Related Equipment. (Philadelphia Electric Co., PA). 14 Mar 1973. 2p. (DOCKET-50278-75). Dep. NTIS $3.00.

26966 (DOCKET-50280-113) SURRY POWER STATION, UNIT 1. Steps Taken to Correct the Deficiencies Brought to Attention in Notice of February 8, 1973. (Virginia Electric and Power Co., Richmond). 16 Mar 1973. 17p. Dep. NTIS $3.00.

26967 (DOCKET-50282-97) PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNITS 1 AND 2. Fish Protection. (Northern States Power Co., Minneapolis, Minn.). 5 Mar 1973. 2p. (DOCKET-50306-92). Dep. NTIS $3.00.

26968 (DOCKET-50285-85) FORT CALHOUN STATION, UNIT 1. Fuel Densification Effects. (Omaha Public Power District, Nebr.). 19 Mar 1973. 25p. Dep. NTIS $3.25.

26969 (DOCKET-50286-63) INDIAN POINT NUCLEAR GENERATING UNIT 3. Applicants Environmental Report, Supplement 4. (Consolidated Edison Co. of New York, Inc., New York). 7 Feb 1973. 341p. Dep. NTIS.

26970 (DOCKET-50286-64) INDIAN POINT NUCLEAR GENERATING UNIT 3. Final Facility Description and Safety Analysis Report, Supplement 12. (Consolidated Edison Co. of New York, Inc., New York). 16 Feb 1973. 213p. Dep. NTIS.
Requested additional information on the Indian Point Unit 3 is presented on the following subjects: cooling system; containment system; engineered safeguards; electrical system; auxiliary systems; testing program; and safety analysis. (JWR)

26971 (DOCKET-50286-69) INDIAN POINT NUCLEAR GENERATING UNIT 3. Final Facility Description and Safety Analysis Report, Supplement 15. (Consolidated Edison Co. of New York, Inc., New York). Mar 1973. 38p. Dep. NTIS $4.00.
Revised and requested data are presented concerning personnel qualifications and the quality assurance program. (DCC)

26972 (DOCKET-50286-70) INDIAN POINT NUCLEAR GENERATING UNIT 3. Summary of Modifications of Electrical Design. (Consolidated Edison Co. of New York, Inc., New York). 2 Apr 1973. 8p. Dep. NTIS $3.00.

26973 (DOCKET-50286-71) INDIAN POINT NUCLEAR GENERATING STATION, UNIT 3. Fuel Densification Report. (Consolidated Edison Co. of New York, Inc., New York). 3 Apr 1973. 122p. Dep. NTIS $8.25.

26974 (DOCKET-50289-92) THREE MILE ISLAND NUCLEAR STATION, UNIT 1. Final Safety Analysis Report, Amendment 37. (Metropolitan Edison Co., Reading, PA). 19 Mar 1973. 54p. Dep. NTIS $4.75.
Revised and additional information is presented concerning the emergency core cooling system core flood line break problem. (DCC)

26975 (DOCKET-50293-125) PILGRIM NUCLEAR POWER STATION. Primary Containment Leak Rate Test. (Bechtel Corp., San Francisco, Calif.). 21 Jun 1972. 497p. Dep. NTIS $27.00.
For Boston Edison Co., MA.

26976 (DOCKET-50295-89) ZION STATION NUCLEAR POWER PLANT, UNITS 1 AND 2. Statement of Illinois EPA that Application Does Meet Requirements. (Commonwealth Edison Co., Chicago, Ill.). 19 Mar 1973. 3p. (DOCKET-50304-82). Dep. NTIS $3.00.

26977 (DOCKET-50295-90) ZION STATION NUCLEAR POWER PLANT, UNITS 1 AND 2. Final Safety Analysis Report, Amendment 27. (Commonwealth Edison Co., Chicago, Ill.). 20 Mar 1973. 104p. (DOCKET-50304-83). Dep. NTIS.
Requested information is presented concerning fuel densification and safety analysis of piping system breaks outside the containment structure. (DCC)

26978 (DOCKET-50295-91) ZION STATION NUCLEAR POWER PLANT, UNITS 1 AND 2. Main Steam Isolation Valve Wall Thickness. (Commonwealth Edison Co., Chicago Ill). 28 Mar 1973. 11p. (DOCKET-50304-84). Dep. NTIS $3.00.

26979 (DOCKET-50298-66) COOPER NUCLEAR STATION. Final Safety Analysis Report, Amendment 17. (Nebraska Public Power District, Columbus). 22 Jan 1973. 57p. Dep. NTIS.
Requested information on the Cooper Power Reactor is presented under the following headings: site; cooling system; containment system; instrumentation and control; radioactive waste systems; and auxiliary systems. (JWR)

26980 (DOCKET-50298-71) COOPER NUCLEAR STATION. Final Safety Analysis Report, Amendment 19. (Nebraska Public Power District, Columbus). 23 Mar 1973. 30p. Dep. NTIS $3.50.
Requested information is presented concerning the reactor site, containment atmospheric dilution, radioactive waste disposal systems, spent fuel cask handling system, and test requirements for main steam isolation valves. (DCC)

26981 (DOCKET-50302-64) CRYSTAL RIVER NUCLEAR GENERATING PLANT, UNIT 3. Final Safety Analysis Report, Amendment 25. (Florida Power and Light Co.). 22 Mar 1973. 342p. Dep. NTIS $19.25.
Revised and additional data are presented concerning technical specifications, safety analysis, personnel, quality assurance program, auxiliary systems, instrumentation, and cooling system. (DCC)

26982 (DOCKET-50305-75) KEWAUNEE NUCLEAR POWER PLANT. Storage and Checking of Reactor Vessel Internals. (Wisconsin Public Service Corp., Green Bay). 22 Jan 1973. 18p. Dep. NTIS $3.00.

26983 (DOCKET-50312-65) RANCHO SECO NUCLEAR GENERATING STATION, UNIT 1. Final Report on Minor Imperfections Found in Pipe Welds. (Sacramento Municipal Utility District, Calif.). 23 Mar 1973. 6p. Dep. NTIS $3.00.

26984 (DOCKET-50313-69) ARKANSAS NUCLEAR ONE, UNIT 1. Electrical Review. (Arkansas Power and Light Co., Little Rock). 13 Mar 1973. 8p. Dep. NTIS $3.00.
Requested information is presented concerning the electrical systems for the reactor. (DCC)

26985 (DOCKET-50315-100) DONALD C. COOK NUCLEAR PLANT, UNITS 1 AND 2. Final Safety Analysis Report, Amendment 40. (Indiana and Michigan Power Co., New York). 30 Mar 1973. 224p. (DOCKET-50316-100). Dep. NTIS $13.50.
Revised and additional data are presented concerning ice condenser containment system performance evaluation. (DCC)

26986 (DOCKET-50317-85) CALVERT CLIFFS NUCLEAR POWER PLANT, UNITS 1 AND 2. Survey Report. (Academy of Natural Sciences of Philadelphia, Pa. Dept. of Limnology). Jan 1973. 145p. (DOCKET-50318-82). Dep. NTIS $9.25.
For Baltimore Gas and Electric Co., MD.

26987 (DOCKET-50320-41) THREE MILE ISLAND NUCLEAR STATION, UNIT 2. Action Taken to Correct Violations of AEC Requirements Brought to Attention Following Inspection of November 1, 2, and 3, 1972. (Metropolitan Edison Co., Reading, Pa.). 29 Dec 1972. 15p. Dep. NTIS.
Additional information concerning coldweld splices in the containment system for the Three Mile Island Nuclear Station, Unit 2 is presented. (JWR)

26988 (DOCKET-50321-69) EDWIN I. HATCH NUCLEAR PLANT, UNIT 1. Final Safety Analysis Report, Amendment 30. (Georgia Power Co., Atlanta). 5 Feb 1973. 152p. Dep. NTIS.
Revised and requested data are presented concerning emergency systems, auxiliary systems, piping systems, quality assurance program, containment system, and operation of cranes. (DCC)

26989 (DOCKET-50321-71) EDWIN I. HATCH NUCLEAR PLANT, UNIT 1. Drywell Air Gap, Removal of Grout and Repair of Concrete Biological Shield. (Georgia Power Co., Atlanta). 20 Mar 1973. 13p. Dep. NTIS $3.00.

26990 (DOCKET-50321-72) EDWIN I. HATCH NUCLEAR PLANT, UNIT 1. Final Safety Analysis Report, Amendment 31. (Georgia Power Co., Atlanta). 28 Mar 1973. 281p. Dep. NTIS $16.25.
Revised and requested data are presented concerning the emergency plan, auxiliary systems, piping systems, electrical systems, instrumentation, cooling systems, and control system. (DCC)

26991 (DOCKET-50324-70) BRUNSWICK STEAM ELECTRIC PLANT, UNITS 1 AND 2. Radiological Environmental Monitoring. (Carolina Power and Light Co., Raleigh, N. C.). 22 Mar 1973. 7p. (DOCKET-50325-71). Dep. NTIS $3.00.

26992 (DOCKET-50324-71) BRUNSWICK STEAM ELECTRIC PLANT, UNITS 1 AND 2. Final Safety Analysis Report, Amendment 16. (Carolina Power and Light Co., Raleigh, N. C.). 2 Apr 1973. 660p. (DOCKET-50325-72). Dep. NTIS $35.00.
Revised and requested data are presented concerning piping systems, cooling system, safety analysis, auxiliary systems, radioactive waste systems, engineered safeguards, containment system, and personnel qualifications. (DCC)

26993 (DOCKET-50327-34) SEQUOYAH NUCLEAR PLANT, UNITS 1 AND 2. Steps Taken to Correct Items of Noncompliance Brought to Attention Following Inspection, December 12-14, 1972. (Tennessee Valley Authority, Chattanooga). 27 Feb 1973. 31p. (DOCKET-50328-32). Dep. NTIS $3.75.
Information is presented concerning welding procedures for the containment shell and piping systems. (DCC)

26994 (DOCKET-50331-88) DUANE ARNOLD ENERGY CENTER. Final Safety Analysis Report, Amendment 13. (Iowa Electric Light and Power Co., Cedar Rapids). 19 Mar 1973. 44p. Dep. NTIS $4.25.
Revised and requested information is presented concerning main steam isolation valve leaks and the combustible gas control system for the containment structure. (DCC)

26995 (DOCKET-50331-89) DUANE ARNOLD ENERGY CENTER. Control Circuits of Safety Related Equipment. (Iowa Electric Light and Power Co., Cedar Rapids). 23 Mar 1973. 1p. Dep. NTIS $3.00.

26996 (DOCKET-50334-57) BEAVER VALLEY POWER STATION, UNIT 1. Reactor Vessel Nozzle Problems. (Duquesne Light Co., Pittsburgh, PA). 1 Mar 1973. 8p. Dep. NTIS $3.00.

26997 (DOCKET-50338-58) NORTH ANNA POWER STATION, UNITS 1, 2, 3, AND 4. Draft Environmental Statement, Comments by Federal Power Commission. (Federal Power Commission, Washington, D. C. (USA)). 22 Mar 1973. 10p. (DOCKET-50339-55; DOCKET-50404-44; DOCKET 50405-44). Dep. NTIS $3.00.

26998 (DOCKET-50346-43) DAVIS-BESSE NUCLEAR POWER STATION. Improper Tack Welds for Class 1 Piping. (Toledo Edison Co., Ohio). 12 Feb 1973. 6p. Dep. NTIS $3.00.

26999 (DOCKET-50346-44) DAVIS-BESSE NUCLEAR POWER STATION. License Application, Amendment 14. (Toledo Edison Co., Ohio; Cleveland Electric Illuminating Co., Ohio). 8 Dec 1972. 77p. Dep. NTIS $6.00.
Financial data on the owners of the Davis-Besse Power Reactor are presented. Estimated annual costs for operating the reactor are listed. The 1971 Annual Reports for the Toledo Edison Company and the Cleveland Electric Illuminating Company are included. (DCC)

27000 (DOCKET-50346-45) DAVIS-BESSE NUCLEAR POWER STATION. Final Safety Analysis Report, Volume 1. (Toledo Edison Co., Ohio). 23 Mar 1973. 576p. Dep. NTIS $31.00.
Information is presented concerning design parameters and the site. (DCC)

27001 (DOCKET-50346-46) DAVIS-BESSE NUCLEAR POWER STATION. Final Safety Analysis Report, Volume 2. (Toledo Edison Co., Ohio). 23 Mar 1973. 689p. Dep. NTIS $36.50.
Information is presented concerning structures, equipment, physics measurements, and cooling system. (DCC)

27002 (DOCKET-50346-47) DAVIS-BESSE NUCLEAR POWER STATION. Final Safety Analysis Report, Volume 3. (Toledo Edison Co., Ohio). 23 Mar 1973. 394p. Dep. NTIS $21.75.
Information is presented concerning the engineered safeguards, instrumentation, and control system. (DCC)

27003 (DOCKET-50346-48) DAVIS-BESSE NUCLEAR POWER STATION. Final Safety Analysis Report, Volume 4. (Toledo Edison Co., Ohio). 23 Mar 1973. 297p. Dep. NTIS $17.00.
Information is presented concerning wiring diagrams for engineered safeguards, auxiliary systems, and control system. (DCC)

27004 (DOCKET-50346-49) DAVIS-BESSE NUCLEAR POWER STATION. Final Safety Analysis Report, Volume 5. (Toledo Edison Co., Ohio). 23 Mar 1973. 335p. Dep. NTIS $18.75.
Information is presented concerning the electrical systems, auxiliary systems, and power conversion system. (DCC)

27005 (DOCKET-50346-50) DAVIS-BESSE NUCLEAR POWER STATION. Final Safety Analysis Report, Volume 6. (Toledo Edison Co., Ohio). 23 Mar 1973. 528p. Dep. NTIS $28.50.
Information is presented concerning radioactive waste disposal systems, radioactive effluents, radiation protection systems, operations aspects, and personnel qualifications. (DCC)

27006 (DOCKET-50346-51) DAVIS-BESSE NUCLEAR POWER STATION. Final Safety Analysis Report, Volume 7. (Toledo Edison Co., Ohio). 23 Mar 1973. 477p. Dep. NTIS $26.00.
Information is presented concerning initial tests, accident analysis, technical specifications, and quality assurance program. (DCC)

27007 (DOCKET-50346-52) DAVIS-BESSE NUCLEAR POWER STATION. Draft Environmental Report, Applicants Responses to Agency Comments. (Toledo Edison Co., Ohio). 28 Mar 1973. 42p. Dep. NTIS $4.25.

27008 (DOCKET-50348-52) JOSEPH M. FARLEY NUCLEAR PLANT, UNITS 1 AND 2. Technical Specifications, Provision for Inspection of Spillway Channel After Discharge. (Alabama Power Co., Birmingham). 21 Mar 1973. 1p. (Docket-50364-44). Dep. NTIS $3.00.

27009 (DOCKET-50348-53) JOSEPH M. FARLEY NUCLEAR PLANT, UNITS 1 AND 2. Improper Tack Welds for Class 1 Piping. (Directorate of Regulatory Operations (AEC), Washington, D. C.). 13 Mar 1973. 2p. (DOCKET-50364-45). Dep. NTIS $3.00.

27010 (DOCKET-50352-35) LIMERICK GENERATING STATION, UNITS 1 AND 2. Draft Environmental Statement, Response to Agency Comments. (Philadelphia Electric Co., Pa.). 23 Mar 1973. 24p. (DOCKET-50353-35). Dep. NTIS $3.25.

27011 (DOCKET-50361-37) SAN ONOFRE NUCLEAR GENERATING STATION, UNITS 2 AND 3. Final Environmental Statement. (Directorate of Licensing (AEC), Washington, D. C.). Mar 1973. 459p. (DOCKET-50362-36). Dep. NTIS $25.00.

The environmental effects of construction and operation of the San Onofre Power Reactor Units 2 and 3 are examined. The descriptions include: (1) the environment in the area, including the history, geography and geology, hydrology, climatology, ecology, land and water use including chemical characteristics, (2) the facility and its effluents, (3) the impacts from construction and operation of the unit, (4) alternatives to the proposed action, (5) irreversible and irretrievable long-term commitments of resources from plant operation, (6) need for power, and (7) the benefits-cost analysis of the proposed plant operation. (DCC)

27012 (DOCKET-50367-36) BAILLY GENERATING STATION, NUCLEAR I. Certification of Indiana Air Pollution Control Board. Extension of no Hazard to Air Navigation Issued by Federal Aviation Administration. Permit for Withdrawal of Water from Lake Michigan. Certification of Stream Pollution Control Board. (Northern Indiana Public Service Co., Hammond). 29 Mar 1973. 11p. Dep. NTIS $3.00.

27013 (DOCKET-50382-54) WATERFORD STEAM ELECTRIC STATION, UNIT 3. Preliminary Safety Analysis Report, Amendment 32. (Louisiana Power and Light Co., New Orleans). 20 Mar 1973. 31p. Dep. NTIS $3.75.

Revised and additional information is presented concerning emergency systems and safety analysis. (DCC)

27014 (DOCKET-50387-31) SUSQUEHANNA STEAM ELECTRIC STATION, UNITS 1 AND 2. Applicants Environmental Report, Amendment 3. (Pennsylvania Power and Light Co., Allentown). 19 Mar 1973. 3p. (Docket-50388-30). Dep. NTIS $3.00.

27015 (DOCKET-50387-32) SUSQUEHANNA STEAM ELECTRIC STATION, UNITS 1 AND 2. Wall Thickness of Nuclear Service Valves. (Pennsylvania Power and Light Co., Allentown). 9 Mar 1973. 11p. (DOCKET-50388-31). Dep. NTIS $3.00.

27016 (DOCKET-50400-37) SHEARON HARRIS NUCLEAR POWER PLANT, UNITS 1, 2, 3, AND 4. Environmental Report, Amendment 24. (Carolinas Virginia Nuclear Power Associates, Inc., Charlotte, N. C.). 3 Apr 1973. 111p. (DOCKET-50401-37; DOCKET-50402-37; DOCKET-50403-37). Dep. NTIS $7.75.

27017 (DOCKET-50404-34) NORTH ANNA POWER STATION, UNITS 3 AND 4. Preliminary Safety Analysis Report, Amendment 15. (Virginia Electric and Power Co., Richmond). 10 Jan 1973. 18p. (Docket 50405-34). Dep. NTIS.

Revised and requested data on the instrumentation, tornado criteria, seismic design, concrete specifications, and containment system for the North Anna Power Station, Units 3 and 4 are presented. (JWR)

27018 (DOCKET-50404-43) NORTH ANNA POWER STATION, UNITS 3 AND 4. Continuous Radioiodine Monitors for Auxiliary Building. (Virginia Electric and Power Co., Richmond). 20 Mar 1973. 3p. (DOCKET-50405-43). Dep. NTIS $3.00.

27019 (DOCKET-50409-41) LA CROSSE BOILING WATER REACTOR. Review of Safety Equipment Control Circuits. (Dairyland Power Cooperative, La Crosse, Wis.). 14 Mar 1973. 2p. Dep. NTIS $3.00.

27020 (DOCKET-50410-23) NINE MILE POINT NUCLEAR STATION, UNIT 2. Application for Licenses, Amendment 10. (Niagara Mohawk Power Corp., Syracuse, N. Y.). 5 Apr 1973. 63p. Dep. NTIS $5.25.

Costs estimates for the Nine Mile Point Power Reactor Unit 2 are presented. The 1972 Annual Report for the Niagara Mohawk Power Corporation is included. (DCC)

27021 (DOCKET-50412-6) BEAVER VALLEY POWER STATION, UNIT 2. Preliminary Safety Analysis Report, Amendment 3. (Duquesne Light Co., Pittsburgh, Pa.). 19 Mar 1973. 578p. Dep. NTIS $31.00.

Revised and requested additional data on the Beaver Valley Power Station, Unit 2 are presented under the following headings: site; buildings and structures; containment system; engineered safety features; auxiliary systems; power conversion systems; and safety analysis. (JWR)

27022 (DOCKET-50412-7) BEAVER VALLEY POWER STATION, UNIT 2. Draft Environmental Statement. (Directorate of Licensing (AEC), Washington, D. C.). Mar 1973. 78p. Dep. NTIS $6.00.

The environmental effects of construction and operation of the Beaver Valley Power Reactor Unit 2 are examined. The descriptions include: (1) the environment in the area, including the history, geography and geology, hydrology, climatology, ecology, land and water use including chemical characteristics; (2) the facility and its effluents; (3) the impacts from construction and operation of the unit; (4) alternatives to the proposed action; (5) irreversible and irretrievable long-term commitments of resources from plant operation; (6) need for power; and (7) the benefits-cost analysis of the proposed plant operation. (DCC)

27023 (DOCKET-50416-15) GRAND GULF NUCLEAR STATION, UNITS 1 AND 2. Preliminary Safety Analysis Report, Revised Amendment 1. (Mississippi Power and Light Co., Jackson (USA)). 22 Feb 1973. 542p. (Docket-50417-15). Dep. NTIS.

Revised and requested additional data on the Grand Gulf Nuclear Station, Units 1 and 2 are presented under the following headings: site; buildings and structures; containment system; instrumentation and control; electrical system; auxiliary systems; radioactive waste disposal systems; and operations and personnel. (JWR)

27024 (DOCKET-50416-16) GRAND GULF NUCLEAR STATION, UNITS 1 AND 2. Preliminary Safety Analysis Report, Amendment 2. (Mississippi Power and Light Co., Jackson (USA)). 26 Feb 1973. 173p. (Docket-50417-16). Dep. NTIS.

Revised and requested data on the site hydrology, engineered safeguards, auxiliary systems, and turbine missile analysis for the Grand Gulf Nuclear Station, Units 1 and 2 are presented. (JWR)

27025 (DOCKET-50416-18) GRAND GULF NUCLEAR STATION, UNITS 1 AND 2. Environmental Report, Amendment 2. (Mississippi Power and Light Co., Jackson (USA)). 19 Mar 1973. 182p. (DOCKET-50417-18). Dep. NTIS $11.25.

27026 (DOCKET-50416-19) GRAND GULF NUCLEAR STATION, UNITS 1 AND 2. Request for Additional Information by Department of Justice. (Department of Justice, Washington, D. C. Antitrust Div.). 29 Mar 1973. 10p. (Docket-50417-19). Dep. NTIS $3.00.

27027 (DOCKET-50423-9) MILLSTONE NUCLEAR POWER STATION, UNIT 3. Environmental Report, Amendment 1. (Millstone Point Co., Hartford, Conn.). 8 Mar 1973. 159p. Dep. NTIS $10.00.

27028 (DOCKET-50423-10) MILLSTONE NUCLEAR POWER STATION, UNIT 3. Preliminary Safety Analysis Report, Amendment 1. (Millstone Point Co., Hartford, Conn.). 8 Mar 1973. 696p. Dep. NTIS $37.00.

Revised and requested data are presented concerning personnel, radioactive waste systems, power conversion system, auxiliary systems, emergency systems, and site. (DCC)

27029 (DOCKET-50423-11) MILLSTONE NUCLEAR POWER STATION, UNIT 3. Notice of Receipt of Application for Construction Permit and Facility License and Availability of Applicant's Environmental Report; Time for Submission of Views on Antitrust Matters. (Directorate of Licensing (AEC), Washington, D. C.). 21 Mar 1973. 15p. Dep. NTIS $3.00.

27030 (DOCKET-50423-12) MILLSTONE NUCLEAR POWER STATION, UNIT 3. General and Financial Information, Amendment 2. (Millstone Point Co., Hartford, Conn.). 30 Mar 1973. 277p. Dep. NTIS $16.00.

27031 (FIND-50321(3-73)) FIND: EDWIN I. HATCH NUCLEAR PLANT UNIT 1. Raleigh, H. D. (ed.) (Technical Information Center (AEC), Oak Ridge, Tenn.). 29 Mar 1973. 36p. Dep. NTIS.

An index to microfiche issuances of safety analysis reports is provided. Subject citations are to specific frames on the microfiche. (JWR)

27032 (NEDO-10698) ENVIRONMENTAL QUALIFICATION OF CLASS I CONTROL AND INSTRUMENTATION EQUIPMENT. von Damm, C. A. (General Electric Co., San Jose, Calif. Atomic Power Equipment Dept.). Nov 1972. 95p.

A general discussion on the environmental qualification of Class I control and instrumentation equipment used in standard General Electric boiling water reactors is presented so that repetitive full reviews of equipment status on a plant-by-plant basis can be avoided. AEC and industry requirements are identified, the results of work performed by General Electric are presented and discussed, and test methods are reviewed. (auth)

27033 (RAI-73-3) REGULATORY ADJUDICATION ISSUANCES, MARCH 1973. (Technical Information Center (AEC), Oak Ridge, Tenn.). 15 Apr 1973. 76p. TIC.

Issuances received from the U. S. Atomic Energy Commission, the Atomic Safety and Licensing Appeal Boards, and the Atomic Safety and Licensing Boards are presented. (JWR)

27034 (REG/G–5.1(12-72)) SERIAL NUMBERING OF FUEL ASSEMBLIES FOR LIGHT-WATER-COOLED NUCLEAR POWER REACTORS. (Directorate of Regulatory Standards (AEC), Washington, D.C.). Dec 1972. 1p. Dep. NTIS. DRS Washington, D. C.

27035 (SZS–134) OPERATIONAL EXPERIENCE GAINED FROM NUCLEAR POWER STATIONS AS A BASIS FOR ASSESSMENT OF NUCLEAR AND RADIATION SAFETY. Kunze, B. (Staatliche Zentrale fuer Strahlenschutz, Berlin (East Germany)). Jul 1972. 28p. (In German). Dep. NTIS (U. S. Sales Only).

The evaluation of operational experience and the determination of failure rates is necessary with regard to safety analyses of nuclear power stations on a probability basis. Published operational experiences are compiled and evaluated. The evaluation shows the failures still occurring and provides some advice on the useful compilation and evaluation of operational data of nuclear power stations. (auth)

27036 (WASH–1218-S2) INDEXES TO ATOMIC SAFETY AND LICENSING APPEAL BOARD ISSUANCES THROUGH DECEMBER 1972. Grissom, M. C. (ed.) (Technical Information Center (AEC), Oak Ridge, TN). 15 Mar 1973. 77p. Dep. NTIS $5.45.

Information on issuances of the Atomic Safety and Licensing Appeal Board is arranged in one or more of the following formats: case name index; digests and headers; legal citation index; subject index; and facility index. (JWR)

27037 IN-SERVICE INSPECTION OF NUCLEAR PLANTS. Sattler, F. J. (Babcock and Wilcox Co., Barberton, OH); Forrer, G. R.; Parker, W. O. Proc. Amer. Power Conf.; 34: 255-267 (1972).

From 34th annual meeting of the American Power Conference; Chicago, Illinois, USA. (18 Apr 1972).

See CONF-720465–.

In-service inspection ensures the mechanical integrity of the primary coolant system during the operating life of a nuclear power plant. Some physical plant and component design considerations, methods, and automated equipment necessary for providing this service are discussed. (FS)

27038 EXPERIENCE IN LICENSING OF NUCLEAR POWER PLANTS. Bliss, H. E.; Stiede, W. L. (Commonwealth Edison Co., Chicago). Proc. Amer. Power Conf.; 34: 268-275(1972).

From 34th annual meeting of the American Power conference; Chicago, Illinois, USA (18 Apr 1972).

See CONF-720465–.

27039 SEISMIC QUALIFICATION OF ELECTRICAL EQUIPMENT FOR NUCLEAR POWER STATIONS. Test, L. D. (General Electric Co., San Jose, CA). Proc. Amer. Power Conf.; 34: 1025-1031(1972).

From 34th annual meeting of the American Power conference; Chicago, Illinois, USA (18 Apr 1972).

See CONF-720465–.

27040 PACKAGING, SHIPPING, RECEIVING, STORAGE, AND HANDLING OF ITEMS FOR NUCLEAR POWER PLANTS (DURING THE CONSTRUCTION PHASE). ANSI N45.2.2-1972. New York; American Society of Mechanical Engineers (1972). 17p.

Requirements for packaging, shipping, receiving, storage, and handling of nuclear power plant items are defined. These items include the parts of structures, systems, and components whose satisfactory performance is required for the plant to operate reliably, to prevent accidents that could cause undue risk to the health and safety of the public, or to mitigate the consequences of such accidents if they were to occur. The requirements stated deal with the protection and control necessary to assure that the requisite quality of those important parts of the plant are preserved from the time items are fabricated until they are incorporated in the plant. (auth)

27041 QUALITY ASSURANCE PROGRAM REQUIREMENTS FOR NUCLEAR POWER PLANTS. ANSI N45.2-1971. New York; American Society of Mechanical Engineers (1971). 9p.

Requirements and guidelines for establishment and execution of quality assurance programs for the design, construction, and operation of nuclear power plants are presented. (JWR)

Steam and Power Conversion Systems

27042 STANDARDIZATION OF THE NUCLEAR STEAM SUPPLY SYSTEM. Arnold, W. H. Jr.; Grain, D. R. (Westinghouse Nuclear Energy Systems, Pittsburgh). Proc. Amer. Power Conf.; 34: 207-215(1972).

From 34th annual meeting of the American power conference; Chicago, Illinois, USA (18 Apr 1972).

See CONF-720465–.

27043 OPTIMIZING THE DESIGN OF BWR POWER PLANTS. Koke, L. C. (General Electric Co., San Jose, CA); Roy, G. M.; Brandon, R. E. Proc. Amer. Power Conf.; 34: 216-227(1972).

From 34th annual meeting of the American power conference; Chicago, Illinois, USA (18 Apr 1972).

See CONF-720465–.

Propulsion and Auxiliary Power Reactors

Refer also to abstracts 24806 and 24807.

27044 (AD-748831) THERMAL HYDRAULIC ANALYSIS OF MH-1A CORE 4. Final Report. Gignilliat, H. C.; Wagoner, James W. III; DeVault, R. M. (Army Engineer Reactors Group, Fort Belvoir, Va. Engineering Div.). 20 Jul 1972. 73p. (ED-7214). NTIS.

Steady-state and transient thermal analyses of the MH-1A Floating Nuclear Power Plant, Core 4 are presented for normal operation and anticipated transients. The reactor core safety limits which form the basis for safe operation and core protection are established in terms of measurable reactor parameters. The ability of the reactor protection system to prevent violation of the core safety limits is demonstrated. The steady-state analysis includes an evaluation of the fuel and clad temperature distribution and the limiting heat flux and coolant enthalpy conditions. Also presented are analyses of limiting reactor transients including uncontrolled rod withdrawal in the power range and during source level startup, secondary system steam line rupture, and loss of reactor coolant flow due to loss of power to both pumps. (auth)

27045 (AI-AEC–13046) SNAP REACTOR PROGRAMS PROGRESS REPORT, AUGUST–OCTOBER 1972. (Atomics International, Canoga Park, Calif.). 28 Feb 1973. Contract AT(04-3)-701. 209p. Dep. NTIS.

Development work during Aug. to Nov. 1972 in the SNAP Reactor Program is reported. Information is included on: the conceptual design of a 5 kW(e) U-ZrH reactor; core hydraulic tests, shield design, and fuel element testing; and development of PbTe thermoelectric conversion system. (LCL)

27046 (GKSS-71/E/16) N. S. "OTTO HAHN." Research Report No. 21. Digital Reactivity Measurement by the Rod Travel Method Onboard the N. S. "Otto Hahn." Schwieger, E. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt m.b.H., Hamburg (West Germany)). 1971. 26p. (In German). Dep. NTIS (U. S. Sales Only).

Described are digital reactivity measurements with the rod drop method which were performed onboard the N.S. "Otto Hahn" during the nuclear start-up program. They aimed at calibration of the control rods and at determination of the isothermal reactivity coefficient. Additional rod drop measurements served the purpose of determining the reactivity behavior following xenon poisoning at the end of a several-day continuous operation at full power. For a better understanding of the experimental results, the reactivity behavior was also calculated according to a simple reactor model. Experimental and theoretical results agreed and, thereby, confirmed the correctness of both the model on which the calculations were based and the reactor physics constants used in the computation. (tr-auth)

27047 (GKSS-72/E/10) N. S. OTTO HAHN RESEARCH REPORT No. 28. Radiation Protection Experience in Operation of the Nuclear Propelled Merchant Vessel "Otto Hahn." Henning, K. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt m.b.H., Hamburg (West Germany)). 1972. 19p. (In German). Dep. NTIS (U. S. Sales Only).

In October 1968, the advanced pressurized water reactor of the N.S. Otto Hahn attained its full power of 38 MW(t). Since then, the first European merchant vessel with nuclear propulsion, which was built essentially for research purposes, has traveled 250,000 nautical miles (10 times the earth's circumference) in 74 voyages without incidents. The total transported load amounted to 283,000 tons of phosphates, ores, and other raw materials. Up to the end of the life expectancy of the first core—the second core will be installed in the fall of 1972—no damage occurred to the fuel elements with steel canning; thus the onboard radiation protection situation was normal. Toward the end of 1971, damage to the heat exchanger occurred, but the radioactivity of the primary water system was so low as to pose no particular radiation protection problems. As a consequence, only experience under routine operation was reported, especially with respect to technical and organizational aspects inherent to the operation of merchant vessels. (tr-auth)

27048 (GKSS-72/E/11) N. S. OTTO HAHN. TEST REPORT NO. 18, CARGO AND TEST TRIP (CRUISE NOS. 65-70) FROM OCTOBER 12, 1971 TO FEBRUARY 20, 1972 TO SFAX, SAFI, AND CASABLANCA; TIME IN SHIPYARD FROM JANUARY 11 TO FEBRUARY 3, 1972. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt m.b.H., Hamburg (West Germany)). 1972. 38p. (In German). Dep. NTIS (U. S. Sales Only).

27049 (GKSS-72-E-20) N. S. "OTTO HAHN." TEST REPORT NO. 19. LOADING AND RESEARCH TRAVEL JOURNEYS NOS. 71-75 TO CASABLANCA IN THE PERIOD FEBRUARY 21–MAY 8, 1972. PRETEST TO FUEL CHANGE IN HAMBURG FROM APRIL 6–APRIL 14, 1972. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt m.b.H., Hamburg (West Germany)). 1972. 35p. (In German). Dep. NTIS (U. S. Sales Only) $3.75.

27050 (JPRS-58457) NUCLEAR ENGINES IN SPACE. Vladimirov, A. Translated from Nauka Zhizn; No. 8, 26-31 (1972). 14p. NTIS.

The possibilities of using rocket engines with nuclear propulsion systems in spacecraft are discussed. (auth)

27051 (LA-3227) EFFECTS OF ADDING HYDROGENOUS MATERIAL TO KIWI REACTORS. Kraig, H. (Los Alamos Scientific Lab., N. Mex.). Dec 1964. Contract W-7405-eng-36. 48p. Dep. NTIS $4.50.

Declassified 19 Mar 1973.

A series of two-dimensional calculations has been employed to study the behavior of KIWI-type reactors as hydrogenous material is introduced. Information on reactivity contribution and fission distribution is presented. Zepo experiments on polyethylene addition and fission distribution are described. 11 references. (auth)

27052 (LA-3229(Suppl.)) PROCEEDINGS OF AN ADVANCED NUCLEAR PROPULSION SYMPOSIUM. Cooper, R. S. (comp.). (Los Alamos Scientific Lab., N. MEX). Jan 1965. Contract W-7405-eng-36. 83p. Dep. NTIS $6.25.

Declassified 19 Mar 1973.

Information on the design of a vortex-stabilized gaseous nuclear rocket and on the feasibility of the HELOIS nuclear-explosion-propelled rocket is presented. (JWR)

27053 (LA-3325) KIWI TRANSIENT NUCLEAR TEST. Fenstermacher, C. A.; King, L. D. P.; Stratton, W. R. (Los Alamos Scientific Lab., N. Mex.). 17 Jun 1965. Contract W-7405-eng-36. 16p. Dep. NTIS $3.00.

Declassified 19 Mar 1973.

The Kiwi Transient Nuclear Test, or Kiwi TNT, was designed to investigate the behavior of a Kiwi reactor under conditions of rapid insertion of abnormal excess reactivity. This test formed part of the Rover Flight Safety Program which has as its objectives the understanding of accident conditions and the providing of information to enable the development of systems and procedures which will ensure safe operation during nuclear rocket flights. The test was carried out on January 13, 1965, at the Test Cell C complex at the Nuclear Rocket Development Station, Jackass Flats, Nevada. A full scale, slightly modified Kiwi graphite reactor was used. To provide for the rapid insertion of reactivity the control drum actuators were modified to increase their speed by a factor of ~100. The abnormal amount of excess reactivity was achieved by removal of internal reactor poisons and decreasing rod shutdown worth. These two modifications enabled an insertion rate of ~$300/sec and a total excess reactivity of ~$6. The experimental instrumentation measured neutron and gamma-ray reaction history, total number of fissions, core temperature and pressures, and internal and external core motions. In addition, optical measurements were made to determine brightness and temperatures of the expanding core. 8 references. (auth)

27054 (LA-3350) DESCRIPTION OF THE KIWI-TNT EXCURSION AND RELATED EXPERIMENTS. King, L. D. P.; Ackworth, D.; Geer, W. U.; Fenstermacher, C. A.; Washburn, B. W.; Weinbrecht, J. F. (comps.). (Los Alamos Scientific Lab., N. Mex.). Jul 1966. Contract W-7405-eng-36. 145p. Dep. NTIS $9.25.

Declassified 19 Mar 1973.

A detailed description of the Kiwi Transient Nuclear Test (Kiwi-TNT) is presented. Background information and the objectives of the test are discussed. A discussion of the operations and test procedures at the Nuclear Rocket Development Station (NRDS) employed prior to, during, and after the excursion is presented. A complete description of the Kiwi-TNT reactor is presented with an emphasis on the modifications used in the Kiwi-TNT reactor as compared with the normal Kiwi-B-4 design. A summary of all the test results is included. A large number of auxiliary external experiments are described. These experiments were carried out to make use of the very large, short neutron and gamma ray burst. A number of power reactor fuels including humerous types of Rover "beaded" fuels were tested in this way in a flux region previously unattainable. 29 references. (auth)

27055 (LA-3577) MONTE CARLO CALCULATION OF GAMMA-RAY HEATING RATES AND FLUXES IN PHOEBUS 1 FROM CORE SOURCES. Watson, C. W. (Los Alamos Scientific Lab., N. Mex.). May 1966. Contract W-7405-eng-36. 39p/ Dep. NTIS $4.00.

Declassified 19 Mar 1973.

Monte Carlo estimates have been made of the gamma-ray heating rates and fluxes in and around a Phoebus 1 reactor from gamma rays originating in the reactor core. The basic input data, as well as the results, are presented in considerable detail. 5 references. (auth)

27056 (LA-3580) CRITICAL ASSEMBLY MOCKUP STUDIES OF THE PHOEBUS 2 ROVER REACTOR. Balestrini, S. J.; Byers, C. C.; Gage, A. M.; Orndoff, J. D. (Los Alamos Scientific Lab., N. Mex.). 15 Jun 1966. Contract W-7405-eng-36. 57p. Dep. NTIS $5.00.

Declassified 19 Mar 1973.

Critical assembly measurements to establish the neutronic features of a 5000 MW Rover reactor are reported. Initial experiments with the Honeycomb critical assembly served to confirm gross features of the design concept. Subsequent measurements with a more realistic mockup (Phoebus 2 Zepo assembly) have established details of reactor and control rod design, effects of structural materials, and fuel loadings required to give adequate excess reactivity with the required flat power distribution. (auth)

27057 (LA-3635) NEUTRON MONTE CARLO CALCULATION FOR A 1000-Mw PROPULSION REACTOR. Watson, C. W.; Graves, G. A.; Streetman, J. R. (Los Alamos Scientific Lab., N. Mex). Jul 1966. Contract W-7405-eng-36. 64p. Dep. NTIS $5.25.

Detailed neutron Monte Carlo calculations have been completed for a simulated Kiwi-B4 reactor, operating at 1000 MW, in order to establish the principal features of internal and external fast-neutron fluxes and reaction rates. In addition to a complete description of the problem input specifications, calculated results are presented for neutron energy deposition rates as a function of position in the reactor system; total and multigroup neutron fluxes and currents at 41 locations within the reactor system; total neutron fluxes and currents for 18 angular positions on each of 4 different external imaginary spheres surrounding the reactor system; $(n,2n)$ and (n,γ) reaction rates for various regions in the system; and complete fast- (greater than 0.1 MeV) neutron balances for the reactor. Computer tapes containing complete state-variables for all collisions in the problem were also accumulated during the calculation. These tapes are processed, as required, to produce certain additional types of data or reclassifications of the original data without necessitating a rerun of the problem. The data given also have application, in the main, to other 1000 MW reactors of similar size and design; e.g., to the Kiwi-B-4E, Phoebus 1A, and Phoebus 1B reactors. (auth)

27058 (LA-3908) CRYOGENIC THERMAL EXPANSION OF Y-12 GRAPHITE FUEL ELEMENTS. Eash, D. T. (Los Alamos Scientific Lab., N. Mex.). Mar 1968. Contract W-7405-eng-36. 4p. Dep. NTIS $3.00.

Declassified 19 Mar 1973.

Thermal expansion measurements between 20°K and 300°K were made on segments of three uranium-loaded Y-12 uncoated graphite fuel elements. (auth)

27059 (LA-3987) SPACE ELECTRIC POWER R AND D PROGRAM. Quarterly Status Report for the Period Ending July 31, 1968. Part II. (Los Alamos Scientific Lab., N. Mex.). 27 Aug 1968. Contract W-7405-eng-36. 11p. Dep. NTIS $3.00.

Declassified 19 Mar 1973.

Physics measurements for ZrH moderated Mo–UO_2 fueled thermionic reactors are presented. Results of irradiation testing of Mo–UO_2 fuel pins are included. (DCC)

27060 (LA-4180) PHOEBUS 2A REACTIVITY ANALYSIS. Hedstrom, J. C.; Kirk, W. L.; Sapir, L. J. (Los Alamos Scientific Lab., N. Mex). 26 May 1969. Contract W 7405-eng-36. 32p. Dep. NTIS $3.75.

Declassified 19 Mar 1973.

The neutronic behavior of the Phoebus 2A reactor, which differed greatly from pre-run predictions, has been subjected to a detailed analysis. Results of the analysis, together with a step-by-step comparison of the present techniques with the pre-run techniques, are reported. Considerably better agreement between analysis and experiment is obtained by changes in the basic neutronic model. (auth)

27061 (LA-4203) LASL ROVER PROGRAM. Quarterly Status Report for Period Ending May 31, 1969. (Los Alamos Scientific Lab., N. Mex.). 26 Jun 1969. Contract W-7405-eng-36. 61p. Dep. NTIS $5.25.

Declassified 19 Mar 1973.

Progress in the ROVER development program is reported. The work covers research on the PEWEE and PHOEBUS reactors, graphite and carbide materials, nondestructive testing of fuel elements, and miscellaneous associated research. (JWR)

27062 (NP-19646) ANNUAL REPORT, 1971. (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schiffahrt m.b.H., Hamburg (West Germany)). 1971. 215p. (In German). Dep. NTIS (U. S. Sales Only).

During 1971, the "Otto Hahn" traveled 17,000 nautical miles during 17 voyages, combining both freight transportation and research. The nuclear propulsion system, especially the reactor, ran without any disturbance that influenced operation of the ship. The second core for the Otto Hahn with zirconium fuel rods and improved neutron economy was built and will be installed during 1972. Based on the operational experience with the Otto Hahn, nuclear ship development work aimed at the design of a container vessel with 80,000 HP propulsion was undertaken. Studies demonstrated that such ships already transcend the threshold above which nuclear propulsion becomes economically superior. Test facilities for components of seawater desalination plants were designed and a site selected. A seawater desalination plant for Iran with a capacity of 5000 m^3/d was also designed. In the two research reactors, the most significant studies concerned burnup experiments on fuel rod bundles, cadmium-containing poison rods, and irradiation of pressure vessel steels. For the design of high-temperature reactors, fuel samples were irradiated at 1200°C and were monitored continuously for fission product release. (HBG)

27063 (ORNL-4276) ROOM-TEMPERATURE MECHANICAL PROPERTIES OF PHOEBUS SUPPORT-ELEMENT GRAPHITE. Yahr, G. T.; Valachovic, R. S.; Smith, J. E. (Oak Ridge National Lab., Tenn.; Wisconsin Univ., Madison. Dept. of Physics). Nov 1968. Contract W-7405-eng-26. 42p. Dep. NTIS $4.25.

Declassified 29 Mar 1973.

Uniaxial tensile and compressive tests were performed on Phoebus central-support-element graphite at room temperature. It was assumed that the material was transversely isotropic and that the monotropic axis coincided with the axis of the element. Stress-strain curves and strain ratio vs axial strain curves were determined for loading both parallel and perpendicular to the axis of the elements. Several specimen geometries were employed, and numerous specimens of each geometry were tested to obtain reliable average mechanical-properties data and to characterize the variability in mechanical properties. Special testing techniques were necessary because of the shape of the elements. A gripping technique was developed that permitted tensile tests on specimens with no reduced section, that is, on specimens of uniform cross section along the entire length of the specimen. This technique made tensile tests on full-cross-section lengths of the elements and of $\frac{1}{16}$-in.-dia microspecimens possible. The $\frac{1}{16}$-in.-dia specimens were used to determine tensile stress-strain behavior both parallel and transverse to the axis of the elements. Thin-walled tubes, subjected to internal pressure in such a manner that no net axial force existed, were also employed to determine transverse mechanical properties. (auth)

27064 (TIM-791) SERVO-AMPLIFIER JOB No. FED 128-220. Banic, C. V. (Pratt and Whitney Aircraft, Middletown, Conn. Connecticut Advanced Nuclear Engineering Lab.). 17 Jun 1964. Contract AT(30-1)-2789. 12p. Dep. NTIS.

Declassified 20 Oct 1971.

A Servo-Amplifier was designed for use in the LCRE reactor control system to control the drum drive shim motors. The Servo-Amplifier was tested in a simulator of the LCRE control system and has accumulated more than 3000 hours of satisfactory operation. (auth)

27065 (TIM-795(Suppl.2)) ONE DIMENSIONAL TRANSPORT CALCULATIONS OF SELF SHIELDING FACTORS FOR IN-PILE CAPSULE TESTS. Alwang, W. G.; Krause, J. (Pratt and Whitney Aircraft, Middletown, Conn. Connecticut Advanced Nuclear Engineering Lab.). 27 Apr 1964. 20p. Dep. NTIS.

Declassified 5 Nov 1971.

The results of Sn transport calculations (DTK code) of the effective self shielding factors for in-pile tests of UN and UC fuels are given. Cylindrical mockups were prepared to represent test locations in ETR, MTR and GETR and the effective self shielding factor versus fuel enrichment was determined. The effect of a tungsten diffusion barrier and of changes in fuel specimen diameter were also obtained. As a check on the validity of the calculated flux spectra, the cadmium ratio as measured with cobalt was compared with values obtained from the DTK calculations. (auth)

27066 (TIM-855(Suppl.6)) IRRADIATION AND EXAMINATION REPORT OF CAPSULE PW 26-523. Carlson, C. E.; Felber, F. F. Jr. (Pratt and Whitney Aircraft, Middletown, Conn. Connecticut Advanced Nuclear Engineering Lab.). 2 Feb 1965. 11p. Dep. NTIS.

Declassified 19 Oct 1971.

Capsule PW 26-523 contained a single test specimen consisting of hyperstoichiometric UC fuel of low density in tantalum lined Cb-1Zr alloy cladding. The test specimen was run for 944 hours at 2190°F at an average power density of 1.4 kW/cc to 0.87 a/o uranium fission burnup. The post test cover gas pressure was 15.2 psia and the specimen diameter increased 1.5% during test. A continuous TaC layer formed on the barrier ID. Chemical analysis of the cladding, after removing the Ta liner, indicated a carbon pickup of from 90 to 560 ppM. Grain growth occurred in the fuel area of the cladding (ASTM #1 grain size). Porosity of the fuel was primarily intergranular and was estimated to be 10-20 v/o. Voids were not interconnected. Axial swelling of the pellets into the spacer area was 15-20 mils. Excess carbon migrated from the fuel center to the OD. The fuel density decrease ranged from 5.9 to 10.1% and the fission gas release was 30.6%. Because of the low density (80% of theoretical), it was expected that the gas release would be considerably higher and, consequently, the fuel swelling would be much lower. The fact that this did not occur may be attributed to the lack of interconnected fuel porosity, which resulted in fission gas pressure buildup in the closed pores. (auth)

27067 (TM-62-3-8) NUCLEAR ROCKET STARTUP AND THRUST CONTROL SYSTEMS. Gorker, G. E. (General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation). 8 Mar 1962. Contract AT(40-1)-2847. 41p. Dep. NTIS.

Declassified 3 Nov 1971.

The results of an analog computer study of nuclear rocket startup characteristics and control systems required for rocket applications are summarized. Calibration of reactivity elements and power sensors is considered along with the failures that might occur due to errors in the calibration. To avoid the dependency upon reactor power measuring sensors, a pneumatic reactivity control system is proposed. Rocket chamber pressure is measured and compared to a desired value and the resulting error inserts or withdraws reactivity. No electrical flux loop is then required once moderate propellant flow has been established. Propellant flow and rocket chamber pressure are scheduled to provide a desired thrust program. (auth)

27068 (TM-62-4-11) HIGH TEMPERATURE LIGHT WEIGHT NEUTRON SHIELDING MATERIALS FOR NUCLEAR-SPACE POWER PLANTS. Baxter, W. G.; Welch, F. H. (General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation). Apr 1962. Contract AT(40-1)-2847. 12p. Dep. NTIS.

Declassified 3 Nov 1971.

Lithium hydride and beryllium with one weight percent (W/O) natural boron were investigated for use as light weight shielding materials. A fabrication developmental program was conducted on LiH for temperatures up to 1000°F and Be-B(1W/O) for temperatures up to 1400°F. Physical properties were obtained and in-pile testing was conducted. A unit casting of LiH weighing 950 pounds in a pre-formed thin-sheet metal stainless-steel container was obtained. The LiH is a low thermal stress resistance material with poor engineering characteristics. A protective coating was developed which permits the Be-B samples to operate in air at 1400°F for periods of time in excess of 1000 hr. (FS)

27069 (TM-62-11-5) STATUS REPORT ON ANALOG COMPUTER STUDIES OF FAST REACTOR CONTROL SYSTEMS. Gorker, G. E. (General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation). 7 Nov 1962. Contract AT(40-1)-2847. 38p. Dep. NTIS.

Declassified 5 Nov 1971.

Transient response and control system stability studies were performed by use of an analog computer to determine any unusual characteristics associated with fast reactors. Temperature, pressure, and density reactivity coefficients were introduced while investigating a number of possible control systems. The first part of this study was concerned more with the reactor characteristics than with the external coolant flow system. Coolant flow was introduced and the reactor control system was required to follow by controlling power so that the desired temperature levels were achieved. The latter part of this study was directed toward achieving satisfactory response for the most severe application, namely that of the nuclear rocket. Any control system which is capable of satisfying the demands of a nuclear rocket can easily be modified to satisfy the requirements of other fast reactor applications. The propellent feed system and the turbopump characteristics were

also simulated using presently available data from North American Aviation. (auth)

27070 (TM-65-1-19) IRRADIATION OF SIX 6BF204 FUEL SPECIMENS IN THE LITR C-48 FACILITY. Elkins, J. D. (General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion operation; Oak Ridge National Lab., Tenn.). 22 Apr 1964. Contract AT(40-1)-2847. 15p. Dep. NTIS.

Declassified 4 Nov 1971.

Six 6BF204 fuel elements were irradiated in the LITR C-48 facility for approximately 550 hours at a maximum temperature of 1232°C. The irradiation history and results of gamma spectrometric analyses of the sample traps are tabulated. (JWR)

27071 (TM-65-6-12) FULL SCALE MOCKUP TEST OF UNCOOLED CONTROL ROD. Tenhundfeld, J. W. (General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation). 15 Jun 1965. Contract AT(40-1)-2847. 9p. Dep. NTIS.

Declassified 4 Nov 1971.

27072 (Y-1868) NERVA FUEL ELEMENT DEVELOPMENT PROGRAM SUMMARY REPORT, JULY 1966–JUNE 1972. Carbons Derived from Organic Compounds. Smith, W. E. (comp.) (Oak Ridge Y-12 Plant, Tenn. (USA)). 3 Feb 1973. Contract W-7405-eng-26. 25p. Dep. NTIS.

This phase of the NERVA program was established to design, procure, develop, and evaluate precursor systems that would allow controlled production of filler and binder graphite, and that would, in combination, allow the production of high coefficient-of-thermal-expansion graphite fuel elements. Filler/binder precursor systems were developed from isotruxene, cinnamylideneindene, acenaphthylene, and commercial petroleum pitches. (auth)

Process Heat and Desalination Reactors

27073 (JPRS-57929) HEAT ENGINEERING PROBLEMS IN NUCLEAR CENTRALIZED HEATING AND POWER CENTERS. Translated from Energetik; No. 7, 5-6(1971) and Teploenergetika; No. 9, 69-73(1972) (8 Jan 1973). 14p. NTIS.

Two papers are presented concerning the development of process heat reactors for space heating in the U.S.S.R. (DCC)

For abstracts of individual papers see: 27074 and 27075.

27074 (JPRS-57929, pp 1-4) BASIC TRENDS IN THE TECHNICAL DEVELOPMENT OF HEAT ENGINEERING. Zinger, N. M. Translated from Energetik; No. 7, 5-6(1971).

27075 (JPRS-57929, pp 5-14) PROBLEMS IN CENTRALIZED HEAT SUPPLY FROM ATOMIC HEAT AND POWER CENTERS. Bunin, V. S. Translated from Teploenergetika; No. 9, 69-73(1972).

Research and Test Reactors

Refer also to abstracts 24638, 24700, 26316, 26702, 26723, and 27114.

27076 (AE-464) MEASUREMENTS AND ANALYSIS OF γ HEATING IN THE R2 CORE. Carlsson, R.; Larsson, L. G. (Aktiebolaget Atomenergi, Studsvik (Sweden)). Jan 1973. 35p. Dep. NTIS (U. S. Sales Only).

Materials are heated in a reactor by either fission heating or by the radiation accompanying the fission. In a materials testing reactor, such as the Studsvik R2 reactor, the gamma heating is of great interest in the design and evaluation of irradiation experiments. Measurements of gamma heating have been performed in different core positions in the R2 using several different materials. These measurements are described in detail, analyzed and correlated with the power distribution in the reactor core. The principles for calculating gamma heating in irradiation devices are described. (auth)

27077 (AE-468) NEUTRON ABSORBER TECHNIQUES DEVELOPED IN THE STUDSVIK R2 REACTOR. Bodh, R.; Sandklef, S. (Aktiebolaget Atomenergi, Studsvik (Sweden)). Jan 1973. 26p. Dep. NTIS (U. S. Sales Only) $3.50.

The R2 is a 50 MW general purpose materials testing reactor. A large number of complicated irradiation tests are performed simultaneously in the core. To achieve specified irradiation conditions for the individual experiments it has become necessary to control the thermal neutron flux level locally. The techniques developed for thermal neutron flux attenuation with emphasis on the use of hafnium, silver and ^{3}He are described. The experimental arrangements are described and measured attenuation characteristics are given. Neutron transport calculations have been successfully applied to the experimental geometries and the results are discussed. (auth)

27078 (AECL-4260) URANIUM BOOSTER ROD EXPERIMENTS IN ZED-2. Part I. Neutron Spectrum Parameter Measurements. French, P. M. (Atomic Energy of Canada Ltd., Chalk River (Ontario). Chalk River Nuclear Labs.). Nov 1972. 83p. Dep. NTIS (U. S. Sales Only). AECL $2.00.

Neutron spectrum parameter measurements were performed in the ZED-2 critical facility with four types of ^{235}U boosters. One type was nominally 20% enriched ^{235}U, 4.74 g ^{235}U/cm length; the other three were 93% enriched with ^{235}U loadings of 2.21 g/cm, 3.49 g/cm, and 4.88 g/cm. The boosters were located interstitially, parallel to reference fuel assemblies. In some experiments, three boosters were inserted in three symmetric configurations that varied the flux coupling between boosters. Measurements were also made with one or three booster assemblies perpendicular to the reference fuel assemblies. Relative gold-copper, lutetium-copper, or indium-manganese, lutetium-manganese activity ratios were determined in the perturbed regions of the core and interpreted in terms of the Westcott spectral parameters r and T_n or $r\sqrt{T_n/T_0}$. The results indicate that spectral perturbations are large near the boosters, but do not extend much more than two or three slowing down lengths from the booster sites. (auth)

27079 (ANCR-1093) PBF TYPE REACTOR AS A DRIVER FOR FISSION-STIMULATED LASER EXPERIMENTS. Brugger, R. M. (Aerojet Nuclear Co., Idaho Falls, Idaho). Nov 1972. Contract AT(10-1)-1375. 31p. Dep. NTIS.

The mechanical and physical characteristics of a PBF type reactor are evaluated to determine whether such a reactor could be used as a neutron source for studying the driving of a laser by the fission process. (auth)

27080 (AWRE-O-57/72) ON-LINE COMPUTER SYSTEM USED IN NEUTRON BEAM EXPERIMENTS ON THE RESEARCH REACTOR HERALD. Maslin, E. E.; Pain, L. F.; Terry, S. H. (Atomic Weapons Research Establishment, Aldermaston (England)). Dec 1972. 31p. Dep. NTIS (U. S. Sales Only). UK pounds 1.

A system is described, developed at the HERALD reactor at AWRE Aldermaston, in which three PDP-8 computers and associated peripherals serve seven neutron beam experiments. The computers function variously as a multi-channel analyzer, data processor and automatic controller. A supervisory program, DAPHNE II, is described which operates in each of the computers and provides flexible operation of the experiments as well as offering several displays and a wide variety of facilities for experimenters to manipulate their data. Typical interfaces between the computers and the experiments are also described. (auth)

27081 (CEA-CONF-2150) FACILITIES FOR IRRADIATION AT LOW TEMPERATURES. Conte, R. R.; Deplerre, Y.; Dural, J.; Morin, H.; Verdier, J.; Weinberg, C. (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). Sep 1972. 15p. (In French). (CONF-721138-3; SM-165/28). Dep. NTIS (U. S. Sales Only).

From Symposium on irradiation facilities for research reactors; Teheran, Iran (6 Nov 1972).

The 20°K installations of Fontenay-aux-Roses (VINKA loop) are mounted with their cryogenerator on a mobile cart whose movement at the base of the loop permits an approach to the core where the flux is 10^{11} to 10^{13} thermal neutrons/cm^2 sec. The control of the pressures makes it possible to stabilize the temperature to ±0.05°K in a region from 20 to 300°K. The installations function automatically. The Grenoble installations are loops with liquid nitrogen or liquid neon fed by cryogenerators with one or four cylinders following the double circuit principle. The approach to the core is made by articulation of the loop base. They also function completely automatically. (tr-auth)

27082 (CEA-CONF-2154) FAST PNEUMATIC INSTALLATIONS. Dailland, R.; Guerin, A.; Lhuillier, H.; Texier, D. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). 1972. 31p. (In French). (CONF-721138-4; SM-165/26). Dep. NTIS (U. S. Sales Only).

From Symposium on irradiation facilities for research reactors; Teheran, Iran (6 Nov 1972).

Two pneumatic installations at OSIRIS for the transfer of short-lived samples have functioned satisfactorily for two years. The characteristics desired in such installations are outlined. The installations are then described and the operation is discussed. Examples are given of their use. (JSR)

27083 (CEA-CONF-2155) IRRADIATION CAPSULES. Franzetti, F.; Laporte, A.; Nectoux, P.; Perrin, J. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires; Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires; Commissariat a l'Ener-

gie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). [nd]. 27p. (In French). (CONF-721138-6; Sm-165/29). Dep. NTIS (U. S. Sales Only).

From Symposium on irradiation facilities for research reactors; Teheran, Iran (6 Nov 1972).

The problems posed by irradiations in swimming pool reactors of average power are resolved because of the availability of perfected irradiation devices. These devices permit irradiations of various samples, of structural material, and fuel in very different surroundings, studies of corrosion by gas or by liquid metals, and in a temperature range from 150 to more than 2000°C with excellent control. Different irradiation devices with their general characteristics are described. (JSR)

27084 (CEA-N-1561) PHYSICS INVESTIGATIONS OF SODIUM COOLED FAST REACTORS. Core Z1 Masurca in Sneak Assembly 6D. Hammer, P.; Plum, F. (comps.) (Commissariat a l'Energie Atomique, Cadarache (French). Centre d'Etudes Nucleaires; Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Angewandte Systemtechnik und Reaktorphysik). Sep 1972. 94p. (In French). (KFK-1581). Dep. NTIS (U. S. Sales Only).

The results of measurements made during 1970 at Karlsruhe on the Z1 Masurca Pu core built into the Sneak 6D facility are presented. The composition of this core is similar to that of the central zone of a 250 MW(e) fast reactor. The experiments were performed in the framework of a joint program between the Cadarache and Karlsruhe laboratories. Two kinds of parameter were studied: cell parameters (spectrum, material buckling, and spectral indices) which characterize the Z1 Masurca cell and enable the cross section sets used for predicting the neutron balance in such a medium; design parameters (critical mass, Na void, power distribution, γ-heating, and control rods), the measurement of which is intended to improve the quality of the calculations used to predict the magnitudes of these quantities for the current SNR Phenix projects. The experimental results obtained at Karlsruhe and Cadarache are presented. When the calculations made in the different laboratories differ, the results obtained in both laboratories are presented and composed with those of the experiment. (France)

27085 (DP-1315) TERMINATION OF NUCLEAR TRANSIENTS IN THE NUCLEAR TEST GAGE. Church, J. P.; Durant, W. S. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.). Jan 1973. Contract AT(07-2)-1. 36p. Dep. NTIS $3.00.

The Nuclear Test Gage at the Savannah River Plant is analyzed for hypothetical transients resulting from supercriticality. Inherent shutdown mechanisms that are independent of the scram systems are postulated for the calculational model. When the scram systems are assumed to be inoperable, these shutdown mechanisms are shown to limit the maximum number of fissions during the transient. For a reactivity addition of unlimited positive linear ramp, the model is used to calculate that a maximum of $\sim 5.3 \times 10^{18}$ fissions have occurred at the time the facility is shut down by inherent self-limiting mechanisms. This is well below the 4.1×10^{19} fissions corresponding to total vaporization of the core. Both the calculated maximum and the core vaporization cases lead to off-site effects below 10-CFR-100 exposure guidelines. The maximum reactivity addition that could be incurred due to charging a test assembly having very high ^{235}U content would not cause a sensible temperature rise if the charging speed is less than 1.5 ft/sec and if the scram system is operable. (auth)

27086 (HEDL-SA-335) ULTRASONIC UNDER-SODIUM VIEWING SYSTEM DEVELOPMENT FOR THE FFTF. Ord, R. N.; Smith, R. W. (Hanford Engineering Development Lab., Richland, Wash.). 15 Apr 1972. Contract AT(45-1)-2170. 14p. (CONF-720607-31). Dep. NTIS.

From 18th Annual American Nuclear Society Conference; Las Vegas, Nevada, United States of America (USA) (18 Jun 1972).

The Fast Flux Test Facility (FFTF) under-sodium viewing system development at the Hanford Engineering Development Laboratory is described. Initial developmental tests of the ultrasonic transducer were performed in an open sodium vessel in a glove box. Although these tests gave very promising results, problems occurred in achieving "wetting" by the liquid sodium of the faceplate of the ultrasonic transducer and in obtaining uniform signals reflected from the surfaces of the targets. Since the initial tests, considerable further experimental work has resulted in understanding the wetting and uniformity problems and in the development of appropriate scanning techniques to produce proper image displays. A more rapid method of scanning using a rotating scanning head has been developed. Both side-viewing (for distance observation) and down-viewing (for high resolution observation) ultrasonic transducers will be incorporated in the prototype scanner concept. A developed three-dimensional perspective imaging method, termed "ISO-SCAN," uses the technique of time-of-flight of the ultrasonic pulse from the scanning transducer to the target surface and the position coordinates of the scanner head. (auth)

27087 (HEDL-SA-346) FISSION GAS CONTROL AT FFTF. Foley, C. J. (Hanford Engineering Development Lab., Richland, Wash.). [nd]. Contract AT(45-1)-2170. 9p. (CONF-720823-17). Dep. NTIS.

From 12th Air Cleaning Conference; Oak Ridge, Tennessee, United States of America (USA) (28 Aug 1972).

The FFTF will operate with continuous noble gas release to the primary system from up to one percent of the fuel. Essentially zero amounts of radionuclides will be released to the environment through the use of high integrity primary sodium system sealing, the Radioactive Argon Processing System (RAPS), and the Cell Atmosphere Processing System (CAPS). In RAPS contaminated argon is pumped to a surge tank and metered into a processing loop consisting of charcoal filled tanks, heat exchangers, a fractionation column and gas circulators. Argon from the fractionation column has noble gas activity of 10^{-5}Ci. Argon/krypton/xenon residue from the column is compressed into an ambient temperature tank for long term storage. Nitrogen from the primary sodium equipment cells is vented to CAPS into a surge tank and metered into the processing equipment consisting of a desicant unit, charcoal delay beds, heat exchanger, gas circulator and then exhausted through the heating and ventilating system. (FS)

27088 (HEDL-SA-383) THREE-DIMENSIONAL ANALYSIS OF THE FTR SHIELD MOCK-UP EXPERIMENT. Boulette, E. T.; Bunch, W. L.; Marr, D. R. (Hanford Engineering Development Lab., Richland, Wash.). 1972. Contract AT(45-1)-2170. 16p. (CONF-721018-8). Dep. NTIS.

From 4th International Conference on Reactor Shielding; Paris, France (9 Oct 1972).

Diffusion theory analyses of the Fast Test Reactor (FTR) Engineering Mock-Up Critical experiments demonstrate that diffusion theory is adequate for calculating the neutron flux distribution in a fast reactor environment. The analyses also indicate that no significant neutron streaming can be associated with the FTR below-core shield. In addition to these results, the overall FTR shielding experimental program is discussed. (auth)

27089 (HEDL-SA-406) FTR NEUTRONICS: STATUS, PROBLEMS, AND DEVELOPMENT PROGRAMS. Hofmann, P. L. (Hanford Engineering Development Lab., Richland, Wash.). May 1972. Contract AT(45-1)-2170. 49p. (CONF-720901-17). Dep. NTIS.

From Meeting on New Developments in Reactor Physics and Shielding Calculations; Keamesha Lake, New York, United States of America (USA) (12 Sep 1972).

The nuclear design features of the FTR are summarized. Plans for nuclear startup and irradiation testing programs are described. 93 references. (auth)

27090 (HEDL-TME-72-68) FFTF CONTROL ELEMENT HYDRAULIC TESTS. Keyes, R. E.; Collingham, R. E. (Hanford Engineering Development Lab., Richland, Wash). Nov 1972. Contract AT(45-1)-2170. 68p. AT $5.45.

Hydraulic tests of a near-prototypic FFTF control element assembly were performed at HEDL at 90°F and results converted to sodium flow conditions at 700°F. Results of the tests provided pressure drop and flow distribution information for the control elements. The float test confirmed predictions made by the control element designer. (auth)

27091 (HEDL-TME-72-142) INFLUENCE OF SODIUM VAPOR TRAPS ON VALIDITY OF COVER GAS SAMPLES. Barton, G. B. (Hanford Engineering Development Lab., Richland, Wash.) Dec 1972. Contract AT(45-1)-2170. 29p. AT $4.00.

Measurements have been made at HEDL which define the effect of a controlled cooling profile, refluxing sodium vapor trap on the concentration of impurities in an analytical sample of FFTF argon cover gas passed through the vapor trap. Methane and nitrogen concentrations in the cover gas sample are only slightly affected by the vapor trap. Changes and trends in hydrogen concentration can be readily detected. Carbon monoxide undergoes extensive decomposition in the vapor trap. If present in the sample, reactive gases such as oxygen, water vapor, and carbon dioxide will not survive the reactions taking place in the sodium vapor trap. (auth)

27092 (HEDL-TME-72-150) RESULTS OF SODIUM REMOVAL TESTS ON IHX LOCKING PIN SUBASSEMBLIES USING THE MOIST NITROGEN, ALCOHOL, AND EVAPORATION PRO-

CESSES. Borisch, R. R.; Maffei, H. P. (Hanford Engineering Development Lab., Richland, Wash). Feb 1973. 28p. AT $4.00.

Experimental work has shown that presence of small weep holes is required in the locking pin joint of the FFTF Intermediate Heat Exchanger (IHX) to assure that adequate sodium removal operations can be conducted when required. (auth)

27093 (INIS-mf-75) CALCULATION OF FAST REACTOR SHIELDING. Burian, J.; Stoces, B. 8p. (In Czech). (CONF-701214-2). INIS.

From 5th conference on nuclear power; Piestany, Czechoslovakia (1 Dec 1970).

Two methods were employed to calculate the shielding of the ZRR experimental fast reactor: a multi-group modification of the diffusion equation and the S_N method of solving the transport equation. Both methods are briefly described, and some of the results are shown. (INIS)

27094 (IS-T-567) STUDY OF AMES LABORATORY RESEARCH REACTOR PHYSICS CHARACTERISTICS BY FEW GROUP DESIGN TECHNIQUES. Crudele, J. S. (Ames Lab., Iowa). Feb 1973. Contract W-7405-eng-82. 129p. Dep. NTIS $8.50.

Thesis.

The Ames Laboratory Research Reactor was studied in R-θ geometry using few group design methods and the data was compared with experimental results. The design procedures used are similar to the technique used for the design of light water moderated reactors. The LEOPARD code, modified for plate-type fuel elements, was used to generate few group neutron cross sections. The diffusion code EXTERMINATOR-2 was used to solve the cell calculations and normal spatial calculations in R-θ geometry. The FOG program was used for its buckling iteration and poison search features. The 24 element core was solved using one-sixth core symmetry and four neutron groups. The 13 element minimum-critical-mass core was solved using one-half core symmetry and only two neutron groups because of its large mesh size of 50×44 mesh points. The 24 element core gave a calculated k_{eff} of 1.1507 which is equal to a reactivity of 13.1 percent. Measured values, using borated poison strips, gave reactivity values that varied from 13 to 16.2 percent depending on the value of β_{eff} used. The calculated value would agree with a β_{eff} of 0.0074. The calculated value of k_{eff} was 1.0038 for the 13 element core. This value agrees reasonably well with the measured value for k_{eff} of 1.0063. Attempts should be made to use four neutron groups to attempt to get better agreement with the measured value. The control rods, in their fully withdrawn position, were worth a k_{eff} of 0.006. The FOG 3 poison search routine was used to add a distributed poison to this rodded region to have the same worth. (auth)

27095 (JAERI-M-4771) RADIONUCLIDES IN THE JRR-2 HEAVY WATER. Suzuki, Y.; Nemoto, T.; Yoshijima, T.; Kamata, T.; Shigemoto, M. (Japan Atomic Energy Research Inst., Tokyo). Mar 1972. 35p. (In Japanese). NTIS (U. S. Sales Only).

The gamma-ray spectra of the JRR-2 heavy water were measured with a Ge(Li) detector, and 18 radionuclides (^{28}Al, ^{41}Ar, ^{60}Co, ^{51}Cr, ^{64}Cu, ^{17}F, ^{59}Fe, ^{132}I, ^{133}I, ^{134}I, ^{135}I, ^{54}Mn, ^{56}Mn, ^{27}Mg, ^{24}Na, ^{99m}Tc, ^{187}W and ^{135}Xe) were detected. Identifications of the radionuclides were made by a combination of gamma-ray spectral analysis, half-time determination and chemical separation. From the identified radionuclides of fission products, the uranium contamination on the surface of the fuel cladding was estimated. (auth)

27096 (JAERI-M-4823) IMPROVEMENTS ON THE INSTRUMENTATION FOR JRR-4. Start-up Channels, Signal Generators, and High-Voltage Supplies. Kinbara, S.; Kimura, K.; Kumahara, T.; Inomata, S.; Usuba, T. (Japan Atomic Energy Research Inst., Tokyo). Jun 1972. 133p. (In Japanese). NTIS (U. S. Sales Only).

Design and fabrication improvements of the instruments for JRR-4 are reported. Following the improvements on the direct-current systems such as linear N channels and log-N period channel which were made in 1968, start-up (pulse) channels, signal generators and high-voltage supplies were improved in this time. The main features of the instruments are the use of modular systems and integrated circuits. Circuit configurations, functions and characteristics of improved instruments which include the start-up channel, signal generators, and high-voltage supplies are described. (auth)

27097 (JAERI-M-4860) MEASUREMENTS OF THERMAL NEUTRON FLUX IN IN-CORE EXPERIMENTAL HOLES OF JRR-4 USING ACTIVATION DETECTORS. Tojo, T.; Kondo, M. (Japan Atomic Energy Research Inst., Tokyo). Jun 1972. 28p. (In Japanese). NTIS (U. S. Sales Only).

The neutron flux distributions in vertical in-core experimental holes (K- and S-pipe) of the Japanese Research Reactor No. 4 (swimming-pool type) have been measured with activation detectors, and the results are given. These measurements were necessary, because of the increase in the loaded fuel and change in the hole position. For the measurements of relative neutron flux activation wires of Cu, Au and Lu-Al alloy were used, and Au foils for the measurements of absolute thermal neutron flux, both by cadmium-ratio techniques. The thermal neutron flux at the peak of its distribution for K-pipe and for S-pipe are 3.05×10^{13} nv ±5% and 3.46×10^{13} nv ±5%, respectively, at reactor full power. (auth)

27098 (JAERI-M-4962) SOME PROBLEMS IN THE INLET COOLANT TEMPERATURE CONTROL SYSTEM OF JMTR. Nakamura, K. (Japan Atomic Energy Research Inst., Tokyo). Sep 1972. 30p. (In Japanese). NTIS (U. S. Sales Only).

In JMTR, the inlet coolant temperature control is regulated by the flow rate in the secondary cooling system. The number of the cells of the cooling tower was designed for reactor operation and irradiation. This control method is not used at present because an uncontrollable temperature region exists in winter. The cooling system of JMTR was studied in detail. A computational code has been developed to estimate the temperature distributions of the reactor cooling system in the steady-state. Good agreement was obtained between the calculation and the observation. Some problems in the design of the cooling system and the feasibility of the inlet coolant temperature control are described. (auth)

27099 (JEN-248) ANNUAL REPORT ON JEN-1 REACTOR. Montes, J. (Junta de Energia Nuclear, Madrid (Spain)). 1972. 34p. (In Spanish). Dep. NTIS (U. S. Sales Only) $3.75.

The main features of the JEN-1 reactor operations and maintenance during 1971 are described. The reactor has been critical for 1831 hours which is 65.8% of the total working time. Maintenance and pool water contamination have occupied the rest of the time. The maintenance schedule is shown in detail. The main failures and reactor scrams are also described. The daily maximum values of the water activity are given as well as the activity of the air in the reactor building. (auth)

27100 (JUL-865-RG) INSTRUMENTATION AND PROGRAMMING METHODS FOR ON-LINE DATA ACQUISITION IN REACTOR PHYSICS MEASUREMENTS WITH THE PDP 15/30 COMPUTER. Diehl, W. (Kernforschungsanlage, Juelich (West Germany). Institut fuer Reaktorentwicklung). Jun 1972. 135p. (In German). Dep. NTIS (U. S. Sales Only).

A description is presented of instrumentation and programming methods for on-line data acquisition in critical and subcritical experiments for determination of some nuclear reactor-physical data. The given programmes are suitable in determining the following values: decay constant of a neutron field, distribution of pulse rates, flux variation in inverse kinetic measurements, doubling time and extrapolation of the critical mass in loading experiments. Another programme determines the long-time stability and calibration of multi-channel analyzers. The circuit drawings, block- and timing-diagrams are given in the annex to explain text and programme flow charts. The listings of the programmes are written in FORTRAN and partially in assembler language MACRO-15. (15 references) (auth)

27101 (LA-4037-SOP, Rev.) OPERATING PROCEDURES FOR THE PAJARITO SITE CRITICAL ASSEMBLY FACILITY. Orndoff, J. D.; Paxton, H. C. (Los Alamos Scientific Lab., N. Mex.). Jan 1973. Contract W-7405-eng-36. 9p. Dep. NTIS $4.00.

27102 (ORNL-TM-4115) BULK SHIELDING FACILITY QUARTERLY REPORT, OCTOBER, NOVEMBER, AND DECEMBER OF 1972. Tabor, W. H.; Hurt, S. S. III; Lance, E. D. (Oak Ridge National Lab., Tenn.). Mar 1973. Contract W-7405-eng-26. 29p. Dep. NTIS.

The BSR operated at an average power level of 1839 kw for 25% of the time during October, November, and December. Water-quality control in both the reactor primary and secondary cooling systems was satisfactory. There was one unscheduled shutdown during the quarter. Changes as authorized by Reactor Instrument and Controls Design Change Memo BSR-2Mw-38 were completed. The BSR was operated at low and variable power during this quarter for 40 hrs as a training aid for three trainees from the Tennessee Valley Authority (TVA) Sequoyah Nuclear Power Reactor. The PCA was operated during the quarter as follows: two days as a training aid for students from the Nuclear Engineering Department of the University of Kentucky and four days as a training aid for trainees from the TVA Sequoyah Nuclear Power Reactor. (auth)

27103 (ORNL-TM-4146) HIGH FLUX ISOTOPE REACTOR QUARTERLY REPORT, OCTOBER-DECEMBER 1972. McCord, R. V.; Corbett, B. L. (Oak Ridge National Lab., Tenn.). Mar 1973. Contract W-7405-eng-26. 22p. Dep. NTIS $3.25.

Two long shutdowns, one of 107 hours for a semiannual component inspection and the other of 59 hours caused by terrorist

threats, reduced the operating time to 90.2% this quarter. However, the operating time for the year 1972 was 93.3%, a record high for the HFIR. A broken lower track bearing mount discovered during the component inspection necessitated replacement of the lower track assembly. All four pieces of semipermanent beryllium were replaced because of cracks after accumulating ~190,000 MWd of exposure (neutron fluence for E > 0.821 MeV of ~2.5×10^{22} NVT). (auth)

27104 (ORNL-TM-4151) OAK RIDGE RESEARCH REACTOR QUARTERLY REPORT, OCTOBER–DECEMBER 1972. Tabor, W. H.; Hurt, S. S. III (Oak Ridge National Lab., Tenn.). Mar 1973. Contract W-7405-eng-26. 39p. Dep. NTIS $4.00.

The ORR operated at an average power level of 29.9 MW for 92.2% of the time during October, November, and December of 1972. Thirty-seven fuel elements were declared spent (^{235}U content ~120 g) during the quarter, while twenty-five new elements were placed in service. The apparent imbalance in numbers of elements reflects an attempt to decrease the inventory of partially depleted elements. Burnup of the shim-rod elements depleted during the year averaged 87.2%, up ~23% from previous years. The reactor was shut down on 10 occasions, 8 of which were scheduled. The total downtime was only approximately 172 hrs, lower than usual because there was only one end-of-cycle shutdown. Unscheduled downtime, however, totaled 10.667 hrs for only two shutdowns since refueling was required on both occasions. Minor difficulties were encountered with the operator assembly (magnet) for the No. 5 shim-rod drive, and the assembly was replaced. The operator assembly which was replaced had been in service for only four months. Special tests or measurements completed during the quarter included: (1) gamma flux measurements in the core, (2) beam-hole flux measurements, (3) MoO_3 mock-up flux measurement, and (4) beam-flux enhancement runs. (auth)

27105 (RT/ING–(72)10) PROBLEMS CONNECTED WITH SODIUM FUEL INTERACTION IN THE PEC REACTOR SAFETY EVALUATION. De Cecco, L.; Santandrea, E. (Comitato Nazionale per l'Energia Nucleare, Rome (Italy)). 23 Jun 1972. 28p. (CONF-720109–3; RVT-PEC–610). Dep. NTIS (U. S. Sales Only).

From meeting on sodium-fuel interaction in fast reactor safety; Grenoble, France (25 Jan 1972).

Problems connected with sodium fuel interactions in the PEC reactor safety evaluation are examined. Formal requirements for the final design of fuel and control system are discussed. Preliminary results of theoretical studies evaluating the conversion of thermal energy to mechanical energy in a fuel-coolant thermal reaction are given. (auth)

27106 (SC-M-710290) OPERATING MANUAL FOR THE SANDIA ACPR. Morris, F. M. (Sandia Labs., Albuquerque, N. Mex.). Nov 1971. 167p. Dep. NTIS $10.50.

27107 (SC-RR-720904-A) PRELIMINARY SPR III SAFETY ANALYSIS REPORT. Coats, R. L.; Jefferson, R. M. (Sandia Labs., Albuquerque, N. Mex.). Jan 1973. 42p. Dep. NTIS.

Supersedes SC-RR-720904.

27108 (UCRL-74443) SUPER KUKLA OPERATING EXPERIENCE, 1964–1973. Peterson, L. R.; Kelley, R. E. Jr. (California Univ., Livermore. Lawrence Livermore Lab.). 16 Feb 1973. 22p. (CONF-730212-1). Dep. NTIS $3.25.

From Fast pulsed reactor symposium; White Sands Missile Range, New Mexico, USA (20 Feb 1973).

The Super Kukla prompt burst reactor has been in operation since October 1964. The reactor and the samples irradiated in its central sample cavity are large. Wide variations in reactivity and kinetic behavior routinely provide operational problems that are uncommon at other burst reactors. Super Kukla reactor operating experience, techniques, and procedures are reviewed. (auth)

27109 DOSE RATE STABILITY OF A BIOLOGICAL IRRADIATION FACILITY AT A THERMAL REACTOR. Zarand, P. (National Research Inst. for Radiobiology and Radiohygiene, Budapest). Acta Biochim. Biophys. (Budapest); 7: No. 2, 187-188(1972).

The dose rate stability of the biological irradiation facility at the Budapest WWR-SM reactor was measured during a 3 month period. The variation was less than 4% which is quite satisfactory for biological experiments. (JWR)

27110 CRYOGENIC DEVICE. Bertrand, G.; Ewald, R.; Perroud, P. (to Commissariat a l'Energie Atomique). French Patent 2,114,126. 30 Jun 1972. Filed date 17 Nov 1970. 8p. (In French).

A cryogenic device is described. The device enables large quantities of heat to be transferred between a boiler and a condenser. A cryogenic liquid (most probably deuterium) irradiation loop is presented. The device is provided with a vessel, the lower part of which is introduced into the heat source; this lower part is extended by a vertical column; a central tube serves to lead the liquid phase cryogenic fluid into a liquid bath situated at the lower part of the vessel. The vessel is contained in an evacuated enclosure. Together with the column, the tube defines an annular space concentric with the tube which contains the liquid phase. The vapor phase cryogenic fluid escapes from this annular space. The roof of the enclosure is provided with a liquid cooled heat exchange wall, which is provided with surfaces upon which the cryogenic fluid condenses. The tube is terminated at its upper part by a joining funnel positioned beneath the condenser, which collects the cryogenic liquid trickling off the condenser walls. In the case of pool type reactors, the column and the tube may be in the form of two conical sections joined by an oblique conical section. (FR)

Production Reactors

27111 (DP-1316) CONFINEMENT OF AIRBORNE RADIOACTIVITY. Progress Report, January–June 1972. Evans, A. G.; Jones, L. R. (Du Pont de Nemours (E. I.) and Co., Aiken, S. C. Savannah River Lab.). Jan 1973. Contract AT(07-2)-1. 44p. Dep. NTIS $3.00.

A new 1.6 MCi ^{60}Co gamma-irradiation facility and associated carbon testing facility were constructed, and testing was begun on candidate replacement carbons for the confinement system. Radiation testing of other confinement system components was also initiated. Carbons are tested for iodine penetration at an absorbed dose rate of 3.0×10^7 rad/hour, and other system components at dose rates ranging from 3×10^6 rad/hour to 4.5×10^7 rad/hour. Initial test results indicate that radiolytic desorption of iodine from carbon increases with increased relative humidity, carbon granule size, and loading times. Desorption is relatively unaffected by dust loading on the moisture separator or particulate filter upstream of the test bed. Both radiation exposure and normal service were found to decrease water repellancy and tensile strength of the particulate filter media. Radiation also causes degradation of fluorocarbon fibers in the moisture separator media and of sponge gasketing material used to seal particulate filters and carbon beds. (auth)

27112 (HW-79359) CALCULATION OF "PRODUCTION FRACTIONS" FOR "MIXED" TYPES OF FUEL CHARGES WITHIN A SINGLE PROCESS CHANNEL FOR THE N-REACTOR. Hagie, L. T. (General Electric Co., Richland, Wash. Hanford Atomic Products Operation). 24 Oct 1963. 7p. Dep. NTIS.

Nuclear material accounting procedures for MWD and Pu dictate that credits be accumulated by fuel models (i.e., factor weights) in reactor process channels and for reactor discharges. When a single type of fuel is charged in a process channel, there is no problem. When more than one model is irradiated in a single tube, however, it is desirable to accumulate MWD credits on the basis of an assumed cosine distribution of flux from front-to-rear. The method used by the N-Reactor Product Accounting System is described. (auth)

Reactor Components, Fuels, and Accessories

Refer also to abstracts 24530, 24824, 25087–25090, 25092, 25093, 25095, 25096, 25100–25103, 25119, 25125, 25187, 25251, 25263, and 26772.

27113 (BNWL-SA-3938) THERMAL REACTOR MIXED-OXIDE FUEL PERFORMANCE. Freshley, M. D. (Battelle Pacific Northwest Labs., Richland, Wash.). Oct 1971. Contract AT(45-1)-1830. 24p. (CONF-711009-15). Dep. NTIS.

From Joint Meeting of the American Nuclear Society; Miami Beach, Florida, United States of America (USA) (17 Oct 1971).

The irradiation performance of Zircaloy clad PuO_2–UO_2 fuel elements in thermal reactors is reviewed. Irradiation characteristics of the fuel elements are discussed concerning cladding distortion, fission gas release, fuel restructuring, plutonium redistribution, fuel-cladding reaction, defect behavior, and transient behavior. 30 references. (DCC)

27114 (DP-Report-642) CORRELATION OF GRAPHITE IRRADIATIONS IN THE HIGH FLUX REACTOR PETTEN AND IN HIGH TEMPERATURE REACTORS. Dragon Project. Reed, D. L.; Everett, M. R.; Blackstone, R. (Atomic Energy Establishment, Winfrith (England); Reactor Centrum Nederland, Petten). Sep 1969. 64p. Dep. NTIS (U. S. Sales Only) $5.25.

For Atomic Energy Establishment, Winfrith, Eng.

A method for the correlation of dose rates in graphite irradiated in the Petten High Flux Reactor and the Dragon High Temperature Reactor in terms of the DIDO nickel dose scale is presented. Both experimental and theoretical techniques for obtaining the ratio of damage flux to nickel flux are described. (JWR)

27115 (EURFNR-1039) HIGH-TEMPERATURE EMBRITTLEMENT. Closs, K. D. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Material und Festkoerperforschung). Jul 1972. 36p. (KFK-1450). Dep. NTIS $4.00.

Work performed under United States-Euratom fast reactor exchange program.

A summary on high temperature embrittlement is given. The basic mechanism is explained by means of the bubble model. As an example, the possibilities for influencing high temperature embrittlement are discussed for the austenitic stainless steel with the number 1.4970. Helium generation in the reactors BR2, SNR and DFR is calculated and compared for the steels number 1.4988 and 1.4970. The effects different He concentrations from cyclotron and reactor irradiations have on the amount of embrittlement are examined for the stainless steel AISI 304. (auth)

27116 (EURFNR-1046) COMPUTER PROGRAM SATURN 1A FOR FUEL RODS. Kaempf, H.; Elbel, H.; Depisch, F. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Material und Festkoerperforschung; Allgemeine Elektricitaets-Gesellschaft, AEG Telefunken, Grosswelzheim (West Germany)). Sep 1972. 69p. (KFK-1575). Dep. NTIS $5.45.

Work performed under United States-Euratom fast reactor exchange program.

The computer code SATURN 1a analyzes the in-pile behavior of a fuel pin in detail. It solves the problem of how to describe the mutual dependence of material phenomena occurring in the fuel pin by means of suitable relations of materials behavior models. The thermal and mechanical as well as radiation effects of the fuel pin are evaluated as a function of the actual reactor operating history. The code is restricted to analyzing a pellet of the fuel pin under the assumption of axial symmetry and plane strains. Models of materials behavior describe the following processes: creep of fuel and clad, fuel swelling due to solid and gaseous fission products, clad swelling due to void nucleation, pore migration, fuel cracking and crack healing, and mechanical interactions between fuel and clad. From initial state, elementary material data, and characteristic data of the reactor operating history, the code computes as a function of time: geometry of fuel and clad, radial distributions of temperature, stresses, and strains in fuel and clad, radial distributions of pores and cracks within the fuel, and contact pressure between fuel and clad. (auth)

27117 (RDT-P-2-5-T(2-73)) MEDIUM VOLTAGE SWITCHGEAR. (Division of Reactor Development and Technology (AEC), Washington, D. C.). Feb 1973. 15p. RSO.

A standard prescribing requirements for the design, fabrication, testing, and quality assurance for medium voltage switchgear up to 15 kV ratings for nuclear reactors is presented. (WHK)

27118 (TM-63-6-17) FISSION PRODUCT RETENTION POTENTIAL OF OXIDE COATED FUEL PARTICLES BASED ON BeO DISPERSED OXIDE CERAMIC FUEL ELEMENT DATA. Conn, P. K.; Brassfield, H. C. (General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation). 1963. Contract AT(40-1)-2847. 16p. Dep. NTIS.

Declassified 4 Nov 1971.

Fission product release data from BeO dispersed oxide tubes indicate that the potential of BeO coated fuel particles in retaining fission products at high temperatures is excellent. No release by a diffusion process was observed for several hundred to 1700 hours at temperatures of 1400 and 1260°C, respectively, when the fueled particles were surrounded by BeO whereas release by a diffusion process was observed in 100 to 200 hours at ~1300°C when the fuel particles virtually formed a continuous phase in the BeO matrix. (auth)

27119 (TM-66-10-6) REFRACTORY METAL FUEL ELEMENT IRRADIATION. Test Operating Report LTFF-12. Blevins, R. E. (Oak Ridge National Lab., Tenn.). 10 Oct 1966. Contract AT(40-1)/2847. 16p. Dep. NTIS.

Declassified 4 Nov 1971.

The objectives of test LTFF-12 are to determine the physical integrity and fission product retention capabilities of a molybdenum-TZM alloy clad, 40 Mo/60 UO_2 specimen in the LITR C-28 position when irradiated at a temperature of 1800°C (3270°F). (auth)

27120 (TM-67-3-2) LTFF-14 TEST OPERATING REPORT. Blevins, R. E. (Oak Ridge National Lab., Tenn.). 19 Jan 1967. Contract AT(40-1)-2847). 16p. Dep. NTIS.

Declassified 3 Nov 1971.

The objectives of test LTFF-14 are to determine the physical integrity and fission product retention capabilities of a W-30Mo-30Re clad, $40W-54UO_2-6ThO_2$ specimen when irradiated at a temperature of 1650°C (3000°F) for 3000 hours in the C-28 facility of the LITR. (auth)

27121 FLUID REGULATION DEVICE FOR A NUCLEAR FUEL LATTICE. Michel, A. (to Belgonucleaire SA). Belgian Patent 747,593. 19 Mar 1970.

A thermostatic device is described consisting of a reservoir, the walls of which consist of two expandable bellows, which contain an incompressible fluid, the expansion of which produces elongation of the bellows. A reservoir supports a ring that can be displaced within two concentric cylinders with apertures. (BE)

27122 PROCEDURE AND DEVICE FOR THE DETECTION OF FISSION PRODUCTS. Kostic, S.; Le Meur, R. (to Commissariat a l'Energie Atomique). French Patent 2,122,365. 1 Sep 1972. Filed date 22 Jan 1971. 10p. (In French).

A procedure and a device for detecting fission products are presented. The device is applicable to the detection of burst slugs. The procedure involves the high resolution β spectrometry of the short half-life fission products with electric collection. This method minimizes the backscattering effect. Electric collection of the fission products occurs in both faces of very thin metallic pieces mounted with a polyester insulator in the middle of the collection chamber. The radioactivity is measured using two 4π geometry electron detectors. The device consists of a magazine possessing a rotating circular rim provided with holes for the pieces, a spherical collection chamber, two electron detectors having surface areas at least equal to that of the pieces and mounted parallel to one another, a transfer plate successively transferring the pieces, and a transporting part. A convenient coordination of the displacement of the transfer plate and the transporting part enables the piece to be transferred from the magazine to the hole in the plate. This plate then positions the piece in the middle of the chamber, where the different measurements are carried out and then returns to its initial position transferring the piece back to the magazine. (FR)

27123 VIBROCOMPACTION PROCESS FOR NUCLEAR FUEL. Papeleur, P.; Flipot, A.; Stynen, J. (to Belgonucleaire SA). Belgian Patent 746,118. 18 Feb 1970.

A process is described for the fabrication of nuclear fuel bars by pneumatic vibrocompacting of granules of various dimensions by the following steps: the canning tube is filled by allowing granules of different sizes to flow separately but simultaneously into it; during filling the tube is subjected to strong vibrations producing accelerations greater than 10,000 g; and the strong vibration is continued after filling by a variable load on the fuel column. (BE)

27124 GRID FOR NUCLEAR ASSEMBLY. Wertz, J. (to Belgonucleaire SA). Belgian Patent 744,910. 26 Jan 1970.

A spacing grid for a nuclear fuel assembly consists of cylindrical holes arranged in a triangular network and braced in the core against each other and having holes that serve to position the fuel rods provided with five deformations, four of which are rigid support points while the fifth is a spring. (BE)

27125 GRID FOR NUCLEAR FUEL ASSEMBLY. (to Belgonucleaire SA). Belgian Patent 729,681. 1 Mar 1969.

A process is described for soldering the elements constituting a grid for spacing fuel rods in the interior of an assembly of nuclear fuels. It is soldered by laser beams. (BE)

27126 PLUG FOR NUCLEAR FUEL RODS. Van Dievoet, J. P. (to Belgonucleaire SA). Belgian Patent 724,655. 29 Nov 1968.

A method is described for the fabrication of a plug for a fuel element. The plug is cut out in a cross section of refractory-base material containing impurities having been subjected to preferential orientation of the metallic crystals by plastic deformation. (BE)

27127 PLUG FOR NUCLEAR FUEL ROD. Bairiot, H.; Aerts, L.; Huberlant, M. (to Belgonucleaire SA). Belgian Patent 729,680. 11 Mar 1969.

A plug for a nuclear fuel rod is described that contains a mechanism forming a valve. The plug can be blocked by a thermal treatment. (BE)

27128 FUEL ELEMENT FOR NUCLEAR REACTORS. (to Fiat SpA). Belgian Patent 740,036. 9 Oct 1969. Priority date 20 Dec 1968. Italy.

A fuel element for nuclear reactors is described that consists of several fuel rods arranged parallel to one another, a group of

separating and stabilizing devices for the rods in the form of a transverse grid, some elastic means for friction between the rods and the transverse grid, and an exterior jacket as a support element for the construction characterized by the fact that the connection between the rods and the grids and the exterior jacket is accomplished and arranged in a manner that reduces to a minimum the constraints that result from various thermal expansions of the different materials that are used in the construction. These assemblies furthermore are adapted to confer an adequate lateral stability to the grids and to produce a transverse deviation of the ascending stream of cooling liquid in order to improve heat exchange. (BE)

27129 NUCLEAR FUEL RODS. de Burbure de Wesembeek, S. (to Belgonucleaire SA). Belgian Patent 736,200. 17 Jul 1969.

A procedure is described for keeping the fuel in place in the can of a nuclear fuel rod characterized by the fact that a split ring of external diameter greater than the internal diameter of the can is introduced into the can. (BE)

27130 FABRICATION OF NUCLEAR FUEL RODS. Bairiot, H.; Aerts, L.; Chermanne, J. M. (to Belgonucleaire SA). Belgian Patent 729,682. 11 Mar 1969.

A process is described for the fabrication of a fuel rod for a nuclear reactor characterized by the fact that there is added to the interior of the can a compound that is nonvolatile at ordinary temperature but volatile under conditions of reactor operation and which is burned progressively during irradiation of the rod in the reactor. (BE)

27131 THERMAL CONTACT CONDUCTANCE IN REACTOR FUEL ELEMENTS. Jacobs, G.; Todreas, N. (Massachusetts Inst. of Tech., Cambridge). Nucl. Sci. Eng.; 50: No. 3, 283-290 (Mar 1973).

The present theories for in-vacuum gap conductance, h_g, are compared to existing out-of-pile data. It is concluded that the Mikic theory which has not been previously applied to nuclear applications is most suitable for future development. The additional data necessary to estimate the transition pressure and to confirm the predictions of this correlation for nuclear fuel materials are specified. (auth)

Reactor Physics and Core Engineering

Physics

Refer also to abstract 26702.

27132 (AEC-tr-7406) CALCULATIONS OF THE LIFETIMES OF PROMPT NEUTRONS IN A REACTOR BY THE MONTE CARLO METHOD. (Institut Atomnoi Energii, Moscow (USSR)). Translation of Report IAE-2155. 1971. 12p. Dep. NTIS.

In prompt-neutron lifetime calculations it is necessary to estimate the quantity $J = (\zeta, \phi\phi^+)$, where ϕ is the flux, ϕ^+ is the importance function, and ζ is a given function. The method for the Monte Carlo calculation of J is presented in which ϕ and ϕ^+ are computed from the same random walk process. The value of the importance function at point x of phase space may be obtained as a number of neutrons in an "equivalent" critical reactor at $t = \infty$ if one neutron was introduced at $t = 0$ at point x. The proposed method is based on such a definition of the importance function and on the so-called "method with constant number of fission points" which is usually used in Monte Carlo criticality calculations. To calculate the quantity J, the track length estimator is used just as in the case of the calculation of $J_1 = (\zeta, \phi)$ but with additional weights. The weight of each neutron is defined as a number of descendants which this neutron will have after n generations. Such an estimator for J is proved to be unbiased at n, $N \to \infty$ (N is a number of neutrons in one generation). The two-dimensional code MMK-16 was developed which calculates the prompt-neutron lifetime using different approximations (from $n = 1$ to $n = 11$) for the importance function. At $n = 1$ it calculates the mean time from birth of a neutron to its production of a second neutron (the mean production time). Some numerical results obtained with MMK-16 are presented. They are compared with experiments and for spherical systems with results of S_n calculations. (17 references) (auth)

27133 (BNWL-SA-3946) REACTOR PHYSICS DESIGN AND CROSS SECTION NORMALIZATION. Liikala, R. C.; Prezbindowski, D. L.; Uotinen, V. O. (Battelle Pacific Northwest Labs., Richland, Wash.). 1971. 4p. (CONF-711008-6). Dep. NTIS $3.00.

From 19th conference on remote systems technology; Miami Beach, Florida, USA (17 Oct 1971).

The accuracy desired in the physics design of thermal power reactors is generally greater than a priori can be expected when considering the errors in theory and uncertainties in the nuclear data. In an attempt to obtain the desired accuracy, standard engineering practice has been to utilize experimental information as a basis for normalizing calculated results to fit measured values. The adjustment of neutron cross sections has historically been the major vehicle for the adjustments. Results of theory-experiment correlations which illustrate some of the problems encountered with this practice are presented. (auth)

27134 (COO-2052-5) PULSED ACTIVATION TECHNIQUES FOR MEASUREMENTS OF DOPPLER EFFECTS. Final Report. Foell, W. K. (Wisconsin Univ., Madison. Dept. of Nuclear Engineering). 15 Jul 1972. Contract AT(11-1)-2052. 116p. (CONF-720901-18). Dep. NTIS.

From Meeting on new developments in reactor physics and shielding calculations; Keamesha Lake, New York, USA (12 Sep 1972).

The development of pulsed activation techniques for the measurement of Doppler reactivity in reactors is described. The method is illustrated in detail including the data reduction formalism and analysis techniques. (JWR)

27135 (COO-2262-1) FINITE ELEMENT METHOD APPLIED TO NEUTRON DIFFUSION PROBLEMS. Deppe, L. O.; Hansen, K. F. (Massachusetts Inst. of Tech., Cambridge. Dept. of Nuclear Engineering). Feb 1973. Contract AT(11-1)-2262. 124p. (MITNE-145). Dep. NTIS $8.25.

The time-independent, multigroup, two-dimensional neutron diffusion equations are solved in the particular case of a piecewise expansion of the unknown flux solutions in bicubic Hermite polynomials. The matrix formulation is achieved by applying the Galerkin method to the "weak" form of the multigroup equations; the matrix problem is solved through the power iteration method and a Cholesky factorization. Numerical results are presented, as evaluated through a code (CHD), for several small problems and for a 1000 Mw(e) PWR, beginning-of-life core. The main conclusions arrived at through the numerical analysis show the feasibility of extending the domain of the piecewise expansion functions over heterogeneous regions, the actual spatial behavior of the cross sections being accounted for in the inner products arising from the application of the Galerkin method. Results are shown which indicate the accuracy and utility of this particular approach. (auth)

27136 (FRNC-TH-294) USE OF HETEROGENEOUS CALCULATIONS FOR DETERMINING THE BUCKLING OF A SMALL SIZE NATURAL URANIUM-HEAVY WATER LATTICE. Nogueira Carneiro, F. A. [nd]. 91p. (In French). Dep. NTIS (U. S. Sales Only).

Thesis.

Experiments with variable sized heavy water moderated lattices formed from bunches of natural uranium pencils (7 to 19 pencils) are presented. Two lattice pitches were used for each fuel. The experiments were performed in the Eole reactor at Cadarache (this reactor has an enriched fuel zone which provides the complement of neutrons necessary to reach criticality). The axial and radial buckling was measured by the flux mapping method. The results obtained are compared with bucklings already measured for the Aquilon reactor. An attempt was made to improve the results obtained with the small lattices by introducing corrections to the experimental values obtained for the counts. These corrections were calculated using the heterogeneous code Astyanax and enable the reflector and geometrical effects to be substracted from the radial flux curve. (FR)

27137 (HEDL-TME-72-134) 3DP, A THREE DIMENSIONAL PERTURBATION THEORY CODE. Hardie, R. W.; Little, W. W. (Hanford Engineering Development Lab., Richland, Wash.). Dec 1972. Contract AT(45-1)-2170. 76p. Dep. NTIS $5.45.

3DP is a three-dimensional perturbation theory code designed to compute reactivity coefficient traverses, the effective delayed neutron fraction, the neutron generation time, the inhour/δk conversion factor, and cross section activity traverses. The code was developed primarily for use with the three-dimensional diffusion theory code, 3DB. The perturbation equation used in 3DP is consistent with the finite difference equations used in 3DB. Variable dimensioning is utilized to make maximum use of available core storage. To facilitate conversion of 3DP to machines other than the UNIVAC 1108, programming is in standard FORTRAN. A 65K core and 10 scratch (logical) storage devices are required for the current version. (auth)

27138 (HEDL-TME-73-20) MONTE CARLO PROGRAM FOR SAND-II ERROR ANALYSIS. Oster, C. A.; McElroy, W. N.; Marr, J. M. (Hanford Engineering Development Lab., Richland, Wash.). Feb 1973. Contract AT(45-1)-2170. 63p. Dep. NTIS $5.25.

The various errors associated with the SAND-II algorithm are discussed. A Monte Carlo procedure for analyzing the errors is described. Results of this study include the determination of acceptable parameters defining the number of iterations and number of sample cases needed for an acceptable Monte Carlo SAND-II error analysis computer run. (auth)

27139 (IAE-2165) APPLICATION OF FOURIER-SERIES FOR SOLVING SOME HETEROGENEOUS REACTOR PROBLEMS. Gorodkov, S. S. (Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii SSSR, Moscow. Institut Atomnoi Energii). 1971. 20p. (In Russian). INIS.

The solution of a diffusion equation with an infinite set of periodically disposed filamentary sources was found simply in the form of a double Fourier series. The latter diverged logarithmically to some points, which hindered the use of these solutions on a computer. A simple method was proposed for isolating the diverging portion. An example of an exponential experiment on a small channel assembly of rectangular cross section was demonstrated. (tr-auth)

27140 (IBK-654) MULTI: MULTIGROUP OR MULTIPOINT P_3 PROGRAMME FOR CALCULATING THERMAL NEUTRON SPECTRA IN A REACTOR CELL. Matausek, M. V. (Institut za Nuklearne Nauke Boris Kidric, Belgrade (Yugoslavia)). Jun 1968. 34p. Dep. NTIS (U. S. Sales Only) $3.75.

The MULTI program calculates the space energy distribution of thermal neutrons in a multizone, cylindrical, infinitely long reactor lattice cell by using the multigroup or multipoint P_3 approximation. A short description of the algorithm and the program is presented and the instructions needed for its exploitation are given. (auth)

27141 (INDC(CCP)-28/U) NUCLEAR DATA REQUIREMENTS FOR REACTOR SHIELDING CALCULATIONS. Abagyan, A. A.; Dubinin, A. A.; Suvorov, A. P. (International Nuclear Data Committee). 1972. 7p. (CONF-721018-7). Dep. NTIS (U. S. Sales Only).

From 4th International Conference on Reactor Shielding; Paris, France (9 Oct 1972).

It is important for shielding calculations to have a highly accurate knowledge of total cross-sections and elastic scattering angular distributions. General guidance is given regarding the accuracy of the required cross-sections for neutron interactions with nuclei. Reference is made to the incomplete state and insufficient accuracy of nuclear data on spectra of the secondary gamma radiation associated with radiative capture, inelastic scattering and certain other interactions between neutrons and nuclei. 14 references. (auth)

27142 (JAERI-M-4862) MEASUREMENT OF THE MATERIAL BUCKLING OF A SUBCRITICAL ASSEMBLY. Nakajima, T.; Tojo, T.; Kondo, M. (Japan Atomic Energy Research Inst., Tokyo). Jun 1972. 20p. (In Japanese). NTIS (U. S. Sales Only).

In measuring the material buckling of a subcritical assembly, B_M, a correction must be applied to account for the higher harmonics in the flux. Such consideration is particularly important for an assembly containing a single or a group of fast neutron sources instead of a plane source of thermal neutrons as in the case of an actual reactor. To solve the problem, the "radial-flux shape" method using the relation of the complete orthogonality of the Bessel function was developed. This method provides a precise measurement of the buckling of a cylindrical assembly but requires tedious work in treating the data. An attempt is made to improve it further by correcting the effect of higher harmonics as easily and quickly as possible. The radial and vertical bucklings at those heights and radial points in which the higher harmonics are expected to be completely neglected according to the prediction of the radial-flux method are measured. The values obtained from the difference of both bucklings for several different loaded radii are averaged to yield the final result. The present method is a combination of the radial-flux method and the variable loading method. The principle of the "improved flux shape" method and its application to the measurement of the buckling of the Japan Atomic Energy Research Institute Subcritical Assembly with an Am-Be neutron source are described. The result is $B_M = -(5.3 \pm 1.1) \times 10^{-4}$ cm^{-2}. An intercomparison is made between two values of the infinite multiplication factor: (a) one from the critical equation into which the material buckling obtained by the present method is substituted, and (b) another from the equivalent infinite flux-volume-integral method. They are in fairly good agreement and thus the utility of the buckling measurement is evidently demonstrated. (auth)

27143 (LIB/Trans-496) PROMPT SUPERCRITICAL POWER EXCURSIONS IN FAST REACTORS. Haefele, W. Translated by A. Rose (Australian Atomic Energy Commission Research Establishment, Lucas Heights) from Nukleonik; 5: No. 5, 201-208(1963). 24p. Dep. NTIS (U. S. Sales Only).

The critical behavior of a reactor is examined for the case of an external reactivity ramp and with a prompt negative temperature feedback coefficient. The case where delayed neutrons are neglected is especially simple and presents an almost exhaustive analytical treatment. Those cases are examined for which the magnitude of the prompt negative temperature coefficient can be determined from the prompt supercritical power excursion. This method of determining the prompt Doppler coefficient is interesting in the case of fast reactors and allows the use of high temperatures in the fuel material, therefore providing a valuable additional measuring method in critical zero power experiments. The methods developed here are used to illustrate the planned American-German reactor project SEFOR (Southwest Experimental Fast Oxide Reactor) which aims to determine the Doppler coefficient. The practical applicability of the derived formulation, however, allows examination of the effect of delayed neutrons and the possibility of considering this addition in a simple manner. It is shown that in the case in which the reactor was run at zero power before the power excursion ($\phi \simeq 10^7$ n cm^2 sec), the effect of delayed neutrons in the first half of the first power excursion for ramp increases greater than 2 $/sec can be considered by means of a mere re-normalization of the initial flux. (auth)

27144 (N-72-28683) CRITICALITY EXPERIMENT AND ANALYSIS OF MOLYBDENUM REFLECTED CYLINDRICAL URANYL FLUORIDE WATER SOLUTION REACTORS. Fieno, D.; Fox, T.; Mueller, R. (National Aeronautics and Space Administration, Cleveland, Ohio. Lewis Research Center). Jul 1972. 28p. (NASA-TN-D-6878; E-6812). NTIS.

Clean criticality data were obtained from molybdenum-reflected cylindrical uranyl-fluoride-water solution reactors. Using ENDF/B molybdenum cross sections, a nine energy group two-dimensional transport calculation of a reflected reactor configuration predicted criticality to within 7 cents of the experimental value. For these reactors, it was necessary to compute the reflector resonance integral by a detailed transport calculation at the core-reflector interface volume in the energy region of the two dominant resonances of natural molybdenum. (auth)

27145 (RISO-M-1572) TASKS AND PROBLEMS IN REACTOR PHYSICS CALCULATIONS. Michelsen, B.; Neltrup, H. (Danish Atomic Energy Commission, Risoe. Research Establishment). 11 Jan 1973. 18p. (CONF-730114-1). Dep. NTIS (U. S. Sales Only) $3.00.

From Meeting on requirements and status of the prediction of physics parameters for thermal and fast power reactions; Julich, F. R. Germany (23 Jan 1973).

A survey of tasks to be covered in a reactor physics calculation for a power reactor core is presented. Problems discussed are: cross section libraries and updating; synthetic cross sections (e.g., self-shielded, resonance cross sections); deviation between results from different approaches to the three-dimensional diffusion equation; and coupling with hydraulics. (auth)

27146 (Y-DR-96) REACTOR PERIOD-REACTIVITY RELATIONSHIP FOR CHAIN REACTIONS HAVING FISSIONS IN ^{235}U AND ^{238}U. Magnuson, D. W. (Oak Ridge Y-12 Plant, Tenn. (USA)). 26 Jan 1973. Contract W-7405-eng-26. 8p. Dep. NTIS.

The reactor period-reactivity relationship was calculated for three uranium-metal chain reacting systems where 10.48, 11.49, and 14.32% of the neutrons were produced in ^{238}U. Errors in reactivity up to 10% would result if the neutrons were assumed to be produced only in ^{235}U for periods as short as 10 sec. This error is not important when compared to the delayed critical condition but is very important for establishing the period-reactivity scale. (auth)

27147 STUDY OF SEVERAL METHODS FOR ANALYSIS OF CRITICAL ASSEMBLY HETEROGENEITY. Palmer, R. G.; Plummer, J. P.; Nicholson, R. B. (Argonne National Lab., Idaho Falls, Idaho). Nucl. Sci. Eng.; 50: No. 3, 229-242(Mar 1973).

The methods for nonresonant cell homogenization in plate-type fast reactor critical assemblies are discussed and tested against high order S_n transport calculations in one-dimensional geometry. The methods tested show satisfactory agreement with transport calculations. The TESS calculations with bilinear flux-adjoint weighting are slightly preferred over flux weighting with either

TESS or CALHET fluxes. Two different treatments of the leakage in the cell calculation lead to slightly different heterogeneity effects when calculated by flux weighting, but very little difference when calculated by bilinear weighting. A two-dimensional test problem gave some surprising results (negative heterogeneity factor) and has raised some unanswered questions. (auth)

27148 COMPUTATIONAL EXPERIMENTATION ON THE FINITE ELEMENT METHOD IN BARE SLAB CRITICALITY CALCULATIONS. Pitkaeranta, J.; Silvennoinen, P. (Tech. Research Center, Otaniemi, Finland). Nucl. Sci. Eng.; 50: No. 3, 297-300(Mar 1973).

Based on a self-adjoint form of the one-group neutron transport equation, the finite element method is applied to the computation of the critical half-thickness of a bare slab. Different optional schemes are compared numerically. For a given order of approximation it is shown that accuracy can be improved appreciably by a proper implementation of the nonreentrant boundary condition and by using a varying element size. (auth)

27149 APPLICATION OF INVARIANT EMBEDDING TO REACTOR PHYSICS. Shimizu, A.; Aoki, K. Nuclear Science and Technology, Volume 9. New York; Academic Press, Inc. (1972). 191p. $13.50.

Part A covers the reflection and transmission of gamma rays by slabs. Part B treats the application of invariant imbedding techniques to criticality calculations. (JWR)

GENERAL

Energy Economics

27150 (BNL-17433) COST ESTIMATE FOR REMEDIAL ACTION PROGRAM FOR RESIDENCES IN THE GRAND JUNCTION, COLORADO AREA. Kukacka, L. E.; Isler, R. J. (Brookhaven National Lab., Upton, N. Y.). Feb 1973. 27p. Dep. NTIS $3.50.

Cost estimates were made for remedial action in residences in the Grand Junction, Colorado Area in which uranium mill tailings were used as a fill material under and around foundations. Gamma radiation profiles were analyzed and remedial action plans formulated for 226 residences. Removal of all uranium tailings under or within 5-ft of the dwelling was stipulated for all residences in which the external gamma radiation (EGR) level was ≥0.05 mr/hr above background, Level I of the Surgeon General's guidelines. For residences with an EGR ≥0.001 and <0.05 mr/hr above background it was presumed that the radon daughter concentration (RDC) was >0.01 Working Level (WL). In this case, the use of sealants and grouting materials in conjunction with appropriate tailing removal was assumed as an alternative to complete removal of tailings. Economic data have been compiled for 226 homes. Eighty homes had an EGR <0.001 mr/hr above background and therefore required no remedial action. For the other levels the cost estimates ranged from $2360 to $6560. The average for the 226 residences was $2110. Based on the established radiation level criteria and the assumed remedial action plan, a total program cost of $10,000,000 was estimated for the 4800 residences in Grand Junction that have tailings under or near the structure. This is ≈33% lower than a previous estimate of $15,000,000 which was based entirely on the removal of tailings from soil under or near areas in which the gamma radiation level was above background. Compared to the latter, the use of sealants and grouts results in an overall cost reduction of $1,900,000 (≈13%). The remainder of the saving ($3,100,000) is due to the deletion of any remedial action for residences with an EGR <0.001 mr/hr above background and for limiting tailings removal to within 5-ft of residences. (auth)

27151 (CONF-730211-1) TOTAL ENERGY APPLICATIONS: INDUSTRIAL, URBAN, AGRICULTURAL. Beall, S. E. Jr. (Oak Ridge National Lab., Tenn). Jun 1972. 50p. Dep. NTIS.

From National Society of Professional Engineers conference; Washington, District of Columbia, USA (27 Feb 1973).

Improved energy utilization (recycling energy intensive products, better insulation, more efficient air conditioning, etc.) and combined uses of heat and electricity were studied. Applications of heat that remains after electricity is generated provide possibilities for significant savings. Heat from a dual-purpose (electricity and heat) plant costs less than heat generated in a separate burning of fuel because less fuel is consumed and because capital investment and operating charges are shared by the two functions; and there is less air pollution and less waste discharged to the environment. The beneficial use of waste heat was explored, with emphasis on study of the large steam–electric generating systems. The small total energy systems, with emphasis on heat recovery and use, are being evaluated presently. Different ways of making heat available in an electrical-generating system are shown. The penalty in electrical capacity that results from back-pressuring is illustrated. It is shown how steam at different temperatures can be removed from different stages of a turbine, making available a range of temperatures varying from perhaps 75° at the condenser up to several hundred degrees F if high-pressure steam is extracted. (JCW)

27152 (HEDL-SA-474) THERMAL CAPACITY OF OUR NATION'S WATERWAYS. Peterson, D. E.; Sonnichsen, J. C. Jr.; Engstrom, S. L.; Schrotke, P. M. (Hanford Engineering Development Lab., Richland, Wash.). 1972. Contract AT(45-1)-2170. 23p. (CONF-721070-1). Dep. NTIS.

From ASCE annual and environmental meeting; Houston, Texas, USA (16 Oct 1972).

The capacity of the nation's waterways to assimilate and dissipate quantities of waste heat was examined. This was done on a regional basis in a format consistent with the standard reference designation given the nation's major drainage basins by the U. S. Geological Survey. Simulations of the rivers in the basins were evolved. MAXPWR is a steady-state heat-budget model that estimates the thermal capacity of a given reach of river using the concept of equilibrium temperature. The model computes the natural and heated river temperature. The cooling capacity of a system of rivers in a given basin is reviewed in regard to the power demand now and in the future. (JCW)

27153 (NP-19653) SOUTHWEST ENERGY STUDY. An Evaluation of Coal-Fired Electric Power Generation in the Southwest. (Study Management Team (U. S. Dept. of the Interior)). Nov 1972. 281p. NTIS.

The Southwest Energy Task Force was established in May 1971 to study electrical energy generation and transmission in the Southwest. Four energy production levels were assumed in order to examine the effects of coal-fired electric generation using Colorado River Basin coal. The findings and conclusions were presented under the following: energy need and supply, resources available, impacts, mitigation of impacts, alternatives, and informations needs. (JCW)

27154 (NP-19687) FUTURE ENERGY DEMAND AND ITS EFFECT ON THE ENVIRONMENT. Morris, D. N. (Rand Corp., Santa Monica, Calif.). Sep 1972. 52p.

For National Science Foundation, Washington, D. C.

Recent forecasts of energy demand were analyzed, and it was concluded that they are deficient because: (1) most fuels were assumed to be limitless and maintained at constant price, (2) impact of new technology was not fully included, and (3) environmental constraints were not adequately taken into account. This panel reviewed the effect of new environmental standards on the consumption of fossil fuels, on stationary power systems, and on transportation systems and made a preliminary investigation into the use of energy for environmental improvement. Options available for meeting air pollution emission standards now being imposed on fossil fuels include: substitution of cleaner fuels; installation of control equipment; and, in the case of power plants, simply switching from fossil fuels to other sources. The panel expresses pessimism and caution regarding the automobile emission standards for 1974. Additional information is needed in regard to cleaning up the environment when large amounts of energy must be expended. Estimating the overall environmental impact of energy production over the next 30 years is considered very difficult. It was concluded that implementation of energy-conservation policies will require widespread changes in public attitudes toward energy as a commodity. (JCW)

27155 (ORNL-NSF-EP-40) ELECTRICAL ENERGY AND ITS ENVIRONMENTAL IMPACT. Progress Report, December 31, 1972. (Oak Ridge National Lab., Tenn.). Mar 1973. Contract W-7405-eng-26. 123p. Dep. NTIS $8.25.

27156 FUEL POLICY. A study in applied economics. Posner, M. V. London; Macmillan (1973). 355p.

The subject is dealt with in five parts: the basic problems including coal, oil in the British energy market, the gas industry before natural gas, the structure of the electrical supply industry, nuclear energy economics and technology, the methodology of comparison, technical uncertainties, assessment of the uncertainties, the relation between today's fixed investment and tomorrow's costs, how much nuclear plant, and the 1970 resource cost of nuclear plants; pricing primary inputs including the cost of uranium feedstock for nuclear energy, the cost of capital, and the price of labor; natural gas economics including the cost of North Sea gas, the price of UK natural gas, the rate of depletion of gas fields; pricing policies such as bulk supply tariffs for gas and electricity and retail tariffs; and fuel policy, i.e., the making of fuel policy, e.g., the 1967 White Paper, plan and outcome, policy implementation, the costs of policy and errors, financial targetry, prices, investment criteria, and the framework of policy. (UK)

Information Handling

27157 (ORNL-4848, pp 86-89) ECOLOGICAL SCIENCES INFORMATION CENTER. Feb 1973.

In Environmental Sciences Division annual progress report for period ending September 30, 1972.

A brief description is presented of the computerized system of information storage and retrieval in the ecological sciences information center. The thermal effects project and the environmental plutonium data base are briefly discussed. (HLW)

27158 (UCRL-74259) UTILIZATION OF SCIENTIFIC DATA BASES AT LLL USING THE "MASTER CONTROL" COMPUTER PROGRAM. Hampel, V. E.; Wade, J. (California Univ., Livermore. Lawrence Livermore Lab.). Oct 1972. 12p. (CONF-730406-1). Dep. NTIS $3.00.

From AIAA computer network conference; Huntsville, Alabama, USA (16 Apr 1973).

MASTER CONTROL is a computer program designed to unify

storage, manipulation, reorganization, retrieval, and display of information from dissimilar data bases. It is open-ended, user-oriented, and applicable to administrative and scientific purposes. The main characteristics of MASTER CONTROL are the free-form input of Hollerith and numerical data, packed memory allocation and a hierarchial order using pointers for random access, a telegram-like English command language, and options to interrogate and to manipulate data bases in batch-mode, or from remote consoles in a time-sharing mode. (auth)

Law

Refer also to abstracts 24824 and 25079.

27159 (BRH/OBD-73-5) REGULATIONS FOR THE ADMINISTRATION AND ENFORCEMENT OF THE RADIATION CONTROL FOR HEALTH AND SAFETY ACT OF 1968. (Bureau of Radiological Health, Rockville, MD). Nov 1972. 39p. GPO $0.45.

The Radiation Control for Health and Safety Act was signed by the President on October 18, 1968. The purpose of this Act was to protect the public from unnecessary exposure to radiation from electronic products. Radiation covered in the Act was called electronic product radiation and was defined to mean any ionizing or nonionizing electromagnetic or particulate radiation or any sonic, infrasonic, or ultrasonic wave which is emitted from an electronic product as the result of the operation of an electronic circuit in such product. The provisions of the Act give the Secretary, Department of Health, Education, and Welfare, authority to establish and carry out an electronic product radiation control program which shall include performance standards for electronic products. The regulations that have been promulgated under the authority are presented. (CH)

Management

27160 (CEA-CONF-2161) OPERATIONAL MAINTAINABILITY: COLLECTION AND ANALYSIS OF INFORMATION. Guyot, C. (Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires). Aug 1972. 36p. (In French). (CONF-721218-1; CONF-730413-1). Dep. NTIS (U. S. Sales Only).

27161 (K-RA-86) ORGDP MANPOWER PLANNING MODEL. Cressler, T. E. II (Oak Ridge Gaseous Diffusion Plant, Tenn.). 24 Nov 1969. Contract W-7405-eng-26. 17p. Dep. NTIS $3.00.

The ORGDP Manpower Planning Model program, initiated in July 1968, was developed to reduce uncertainty in the area of manpower planning. The input to the program is an employment projection furnished by plant personnel. The basic output of the program generates information concerning projected employment, estimated attrition, estimated promotions, estimated number of personnel needed to meet the next time-period requirement, estimated number of personnel to hire, and an estimate of the number of surplus personnel. The output information is grouped on the basis of plant, division, payroll, and homogeneous job group. The output has implications in the policy and implementation areas of organizational operation. (auth)

27162 (NP-19590) MANAGEMENT PROCEDURES FOR THE CONDUCT OF SCIENTIFIC BALLOON FLIGHTS. (Department of Supply, Mildura (Australia). Balloon Launching Station). Dec 1971. 16p. Dep. NTIS (U. S. Sales Only).

The Australian Dept. of Supply manages the site on behalf of the USAEC for the purposes of conducting high-altitude sampling flights in accordance with USAEC schedules. When not in USAEC use the facilities are available to other scientific users. Standing responsibilities, flight responsibilities, and interfaces with other Australian government organizations are described. (AT)

27163 (REG/G-8-1(2-73)) RADIATION SYMBOL. (Directorate of Regulatory Standards (AEC), Washington, D. C.). 2 Feb 1973. 1p. DRS, Washington, DC Free.

27164 (REG/G-8-2(2-73)) GUIDE FOR ADMINISTRATIVE PRACTICES IN RADIATION MONITORING. (Directorate of Regulatory Standards (AEC), Washington, D. C.). 2 Feb 1973. 1p. DRS, Washington, DC Free.

Mathematics and Computers

27165 (AERE-R-7168) CERTAIN MATRIX EIGENVALUE TECHNIQUES DISCUSSED FROM A GEOMETRIC POINT OF VIEW. Parlett, B. (Atomic Energy Research Establishment, Harwell (England)). Jan 1973. 20p. Dep. NTIS (U. S. Sales Only) $3.00. UK 50 pence.

27166 (AERE-R-7293) FORTRAN SUBROUTINES FOR THE SOLUTION OF SPARSE SYSTEMS OF NONLINEAR EQUATIONS. Reid, J. K. (Atomic Energy Research Establishment, Harwell (England)). Nov 1972. 56p. Dep. NTIS (U. S. Sales Only) $5.00. UK £1.00.

Fortran subroutines are presented in order to solve, in the sense of least squares, sparse systems of nonlinear equations which may or may not be over-determined. A modification of the algorithm of Marquardt is sued. (auth)

27167 (CERN-73-5) SIGMA, A NEW LANGUAGE FOR INTERACTIVE ARRAY-ORIENTED COMPUTING. Hagedorn, R.; Reinfelds, J.; Vandoni, C.; Van Hove, L. (European Organization for Nuclear Research, Geneva (Switzerland). 19 Mar 1973. 68p. Dep. NTIS (U. S. Sales Only) $5.50.

27168 (CONF-691073-1) SET-THEORETIC APPROACH TO THE CONCEPT OF TYPE. Reynolds, J. C. (Argonne National Lab., Ill.). Aug 1969. 58p. Dep. NTIS $5.00.

From NATO conference on techniques in software engineering; Rome, Italy (Oct 1969).

The conventional concept of type used in modern programming languages is limited by the assumption that all type errors must be detectable at compile time. An alternative approach is to permit the ranges of variables, procedure arguments, and function results to be specified by set-theoretic operations such as union, cartesian product, and set exponentiation. This approach offers simplicity, flexibility, and a greater precision in the specification of sets. Certain classes of type error are still detectable at compile-time while others require checking during execution. The set-theoretic approach is illustrated by a simple, purely applicative language. Examples are given and the language is formally defined. (auth)

27169 (COO-1469-213) QUARTERLY TECHNICAL PROGRESS REPORT, JULY, AUGUST, SEPTEMBER. (Illinois Univ., Urbana. Dept. of Computer Science). 1972. Contract AR(11-1)-1469. 164p. (UIUCDCS-APR-72-3). Dep. NTIS $10.25.

27170 (COO-1469-216) APE MACHINE: A NOVEL STOCHASTIC COMPUTER BASED ON A SET OF AUTONOMOUS PROCESSING ELEMENTS. Wo, Y. K. (Illinois Univ., Urbana. Dept. of Computer Science). Feb 1973. Contract AT(11-1)-1469. 111p. (UIUCDCS-R-73-556). Dep. NTIS $7.75.

Thesis.

The system structure and the design of the APE machine are discussed. Some detail analysis is given to its stochastic operations. Its limitations as well as their possible solutions are also presented. (auth)

27171 (COO-1469-217) SEMANTRIX: A SEMANTICALLY GUIDED DIGITAL ELECTRONIC MACHINE. Mudge, T. N. (Illinois Univ., Urbana. Dept. of Computer Science). Feb 1973. Contract AT(11-1)-1469. 102p. (UIUCDCS-R-73-559). Dep. NTIS $7.25.

Semantrix is a digital machine, whose domain of activity (or world) is a rectangular plane or table top. Its activity in the plane can be instructed from either a teletype or a digital computer. Semantrix and a teletype can form a stand alone system. However, to make full use of the machine, a digital computer should be used as a controller. Semantrix can thus be viewed as a special piece of I/O equipment. (auth)

27172 (EUR-4938, pp 89-97) MASS-SPECTROMETRIC KNUDSEN EFFUSION MEASUREMENTS OF VAPOR SPECIES IN THE SYSTEM LITHIUM-HYDROGEN. Ihle, H. R.; Wu, C. H. (Institut fuer Plasmaphysik, Juelich, Ger.). Dec 1972.

From 7th symposium on fusion technology; Grenoble, France (24 Oct 1972).

A knowledge of the partial pressures in equilibrium with liquid lithium-lithium hydride is of importance for the concepts of systems for tritium removal from a lithium blanket, and with respect to wall permeation problems as well. The complexity of the vapor composition in this system demands a complete study of the vapor constituents in dependence on temperature and composition of the condensed phases. The effusion rates of hydrogen and lithium from a Knudsen cell were measured in the temperature range from 425 to 600°C for the two-phase system: Li saturated in LiH and LiH saturated in Li. From the effusion rates of hydrogen and lithium, the partial pressures of all gas species in the system are calculable. In view of the anticipated relatively high density of the gas molecule LiH at a low concentration of hydrogen in lithium ($H/Li < 10^{-4}$), an attempt was made to make possible the direct mass spectrometric measurement of LiH gas molecules. Ions LiH^+ and LiD^+ were observed in studies of the gas species, which are desorbed from a molybdenum membrane inserted in the effusion hole of a Knudsen cell. (auth)

27173 (ISS-72/13) NUMERICAL CALCULUS ELEMENTS. Part I. Salvadori, P. (Istituto Superiore di Sanita, Rome (Italy).

Laboratori di Fisica). 15 Sep 1972. 83p. (In Italian). Dep. NTIS (U. S. Sales Only) $6.25.

27174 (ITF-72-129-P) TOPOLOGY OF LOW-DIMENSIONAL REAL LIE GROUPS. II. Osinovskii, M. E. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1972. 26p. (In Russian). Dep. NTIS (U. S. Sales Only) $3.50.

27175 (JAERI-M-4820) FORMAT PROCESSING ROUTINE FOR ON-LINE FORTRAN. Ishiguro, M.; Yamada, T.; Tsugita, T. (Japan Atomic Energy Research Inst., Tokyo). May 1972. 45p. (In Japanese). NTIS (U. S. Sales Only).

The F230-35 ROS FORTRAN by a computer manufacturer is with many drawbacks. Though ROS FORTRAN is part of the ROS processors (ROS is for Real-Time Operating System), it is not suitable for on-line use. Especially, the FORMAT processing is extremely time-consuming, which is fatal to the on-line system in JAERI. A faster FORMAT processor therefore was developed in the JAERI computing center; it is written in FORTRAN language to reduce its maintenance effort. The processor consists of input and output conversion routines, and the method of conversion differs from the existing ones. The speed of this processor is about 100 times as fast as the manufacturer's one. The processor is resident in core and occupies 9 K bytes. The processor is being used, linked to ROS FORTRAN; for application to other computer systems, its modification in the interface is necessary. (auth)

27176 (JINR-E4-6901) DYSON EQUATION FOR HEISENBERG FERROMAGNET. Plakida, N. M. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 10p. Dep. NTIS (U. S. Sales Only) $3.00.

27177 (KFK-1531) INTERRUPT ORGANIZATION FOR FAST CHANGE OF PROGRAM IN A REAL TIME SYSTEM. Hepke, G.; Herbstreith, H. (Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Datenverarbeitung in der Technik). Jan 1973. 18p. (In German). Dep. NTIS (U. S. Sales Only) $3.00.

27178 (LA-TR-73-3) APPLICATION OF THE FINITE-ELEMENTS METHOD IN TWO-DIMENSIONAL HYDRODYNAMICS USING THE LAGRANGE VARIABLES. Lascaux, P. (Commissariat a l'Energie Atomique, Limeil-Brevannes (France). Centre d'Etudes). Translated by Anna Vakar from French. 1972. 23p. Dep. NTIS $3.25.

It is shown that the conventional descretization schemes used to approximate the equations for conservation of momentum in Lagrangian two-dimensional hydrodynamics may be explained in terms of finite elements. Quadrilateral elements are chosen, with positions and velocities which vary bilinearly, and constant pressures in each element. To calculate the forces of inertia, an approximate squaring formula is used to obtain a matrix of diagonal mass. In this manner, one arrives at a scheme which is nearly identical with Goad's WAT scheme, except for a slight change in calculating the masses of quadrilaterals which are not parallelograms. The difference between the schemes of Goad and of Wilkins for a cylindrical example is pointed out. (auth)

27179 (ORO-4061-7) CODE GENERATION FOR NEW ON THE RICE RESEARCH COMPUTER. Donegan, M. K. (Rice Univ., Houston, Tex. Lab. for Computer Science and Engineering). May 1972. Contract AT(40-1)-4061. 100p. Dep. NTIS $7.00.

Thesis.

A code generation scheme is given for the implementation language NEW to be used on the Rice Research Computer. The runtime organization of NEW programs, which provides for independent compilation of routines and generalized jumps using label variables, is discussed. The code generator is based on an algorithm given by Sethi and Ullman, which has been extended to aid in efficient compilation of NEW constructs. Modes of elaboration are introduced to aid in the handling of assignations and jumps. A heuristic scheme is used to register allocation based on context. Finally, some problems with the language and the computer are discussed, and areas for future work are presented. (auth)

27180 (ORO-4061-9) INTERCHANGE OF ESSENTIAL PROGRAMS BETWEEN DISSIMILAR COMPUTERS. Progress Report, June 1, 1972-May 31, 1973. Feustel, E. A. (Rice Univ., Houston, Tex. Lab. for Computer Science and Engineering). Feb 1973. Contract AT(40-1)-4061. 6p. Dep. NTIS $3.00.

The language processor for the target machine (Rice Research Computer R-2) was largely completed on the host (Burroughs B5500) when the University switched to an IBM 370 Model 155. Work is in progress for the new host, which will produce target machine code. A version of the language processor written in itself is half completed and is continuing. Several essential systems programs have been written in the language and have been syntactically debugged. (auth)

27181 (SC-DR-720782) EMR 6130 (COMPUTER) ON-LINE STATION: PARTIAL-PRESSURE ANALYZER SYSTEM. Longerot, C. D. (Sandia Labs., Albuquerque, N. Mex.). Nov 1972. 30p. Dep. NTIS.

This report describes electronic system hardware modules which allow on-line data acquisition and control associated with a remote partial pressure analyzer station and the centralized EMR 6130 real-time/time-share computer. The on-line capability eliminates a large amount of manual data processing and handling while facilitating more sophisticated data processing. (auth)

27182 (SLL-73-211) OPERATION AND MAINTENANCE DOCUMENT FOR PROGRAM FILTER. Burnett, M. L.; Tichenor, D. A. (Sandia Labs., Livermore, Calif.). Feb 1973. Contract AT(29-1)-789. 83p. Dep. NTIS $6.25.

27183 (Y-IA-112) APPLICATION OF A MINICOMPUTER TO IMPROVE MAINTENANCE TESTING. McMillan, D. E. (Oak Ridge Y-12 Plant, Tenn. (USA)). 1973. Contract W-7405-eng-26. 5p. (CONF-730407-1). Dep. NTIS.

From IEEE southeast conference; Louisville, Kentucky, USA (30 Apr 1973).

Operation of an automatic test system used at the Oak Ridge Y-12 Plant for maintenance testing of digital circuitry has been improved by the addition of a minicomputer. Extension of the computer interface to permit direct testing of certain classes of logic is under investigation. (auth)

Miscellaneous

27184 (ACRH-1000-399) NONSTATIONARY AND NONLINEAR SCINTIGRAM PROCESSING. Metz, C. E.; Pizer, S. M. (Argonne Cancer Research Hospital, Chicago, Ill.). [nd]. Contract AT(11-1)-3333. 35p. (CONF-711065-1). Dep. NTIS.

From 2nd European meeting on data handling and image processing in scintigraphy; Hannover, Federal Republic of Germany (F. R. Germany) (6 Oct 1971).

27185 (AECL-4136) THERMODYNAMICS OF METAL-WATER SYSTEMS AT ELEVATED TEMPERATURES. Part 1. The Water and Copper-Water Systems. Macdonald, D. D.; Shierman, G. R.; Butler, P. (Atomic Energy of Canada Ltd., Pinawa (Manitoba). Whiteshell Nuclear Research Establishment). Dec 1972. 91p. Dep. NTIS (U. S. Sales Only) $6.75.

A computer program is described for calculating free energies of chemical substances in aqueous systems at temperatures to 300°C. The technique is used to derive potential-pH relationships for the water and copper-water systems at 25, 60, 100, 150, 200, 250, and 300°C. The solubilities of Cu and CuO as a function of pH are calculated over the same temperature range. (auth)

27186 (AECL-4218) MODEL OF THE GENERATION TIME DISTRIBUTION OF MAMMALIAN CELLS WHICH INCLUDES THE EFFECTS OF GROWTH TEMPERATURE. Szekely, J. G.; Kennedy, G. G. (Atomic Energy of Canada Ltd., Pinawa (Manitoba). Whiteshell Nuclear Research Establishment). Jan 1973. 45p. Dep. NTIS (U. S. Sales Only) $4.25.

27187 (AERE-R-7093) ELECTRONICS AND APPLIED PHYSICS DIVISION SCANNING ELECTRON MICROSCOPE, 1967 TO 1971. Marshall, D. C.; Stephen, J. (Atomic Energy Research Establishment, Harwell (England)). Nov 1972. 59p. Dep. NTIS (U. S. Sales Only) $5.00. UK 1.00 pound.

27188 (AERE-R-7253) TECHNIQUE FOR THE CALIBRATION OF HIGH PRECISION KELVIN-VARLEY POTENTIOMETERS AND VOLTAGE DIVIDERS. Merrill, A.C.G. (Atomic Energy Research Establishment, Harwell (England)). Dec 1972. 11p. Dep. NTIS (U. S. Sales Only). UK 50 pence.

27189 (AWRE/LIB/BIB-24) SWEAT: CHEMICAL COMPOSITION. BIBLIOGRAPHY OF REFERENCES PUBLISHED, 1966-1972. Beck, D. (Atomic Weapons Research Establishment, Aldermaston (England)). Jan 1973. 12p. Dep. NTIS (U. S. Sales Only) $3.00. UK 50 pence.

27190 (AWRE-O-1/73) EXPERIMENTAL STUDY OF THE SHOCK WAVE IN FREE AIR FROM SPHERICAL CHARGES OF TNT AND 60/40 RDX/TNT. Potter, R.; Jarvis, C. V. (Atomic Weapons Research Establishment, Aldermaston (England)). Jan 1973. 39p. Dep. NTIS (U. S. Sales Only) $4.00. UK 1£.

27191 (BARC-634) ANNUAL REPORT OF TEST EQUIPMENT AND DISPLAY SYSTEMS SECTION, ELECTRONICS DIVISION, 1970 TO 1971. (Bhabha Atomic Research Centre, Bombay (India)). 1972. 66p. Dep. NTIS (U. S. Sales Only) $5.50.

27192 (BDX-613-670) PREVENTION OF TIN-LEAD OVERHANG IN PLATED COPPER-CLAD PRINTED WIRING BOARDS. Final Report. Swisher, P. L. (Bendix Corp., Kansas City, MO.). Feb 1973. Contract AT(29-1)-613. 26p. Dep. NTIS $4.00.

27193 (BDX-613-778) NONMETALLIC TOOLING CAPABILITIES AND ECONOMICS, FY73-1. Quarterly Report. Freund, R. W. (Bendix Corp., Kansas City, Mo.). Feb 1973. Contract AT(29-1)-613. 11p. Dep. NTIS $3.00.

27194 (BMBW-FBK-72-31) USE OF LOW TEMPERATURES TO DECREASE THE LOSS OF HIGH VOLTAGE OSCILLATING CIRCUITS. Peier, D. (Technische Universitaet, Brunswick (West Germany). Institut fuer Hochspannungstechnik). Dec 1972. 33p. (In German). Dep. NTIS (U. S. Sales Only) $3.75.

27195 (BMBW-BFK-72-32) SWITCHING DEVICE FOR MAKING CONTACT WITH HIGH-VOLTAGE OSCILLATING CIRCUITS OF HIGH QUALITY. Schwarz, U. (Technische Universitaet, Brunswick (West Germany). Institut fuer Hochspannungstechnik). Dec 1972. 24p. (In German). Dep. NTIS (U. S. Sales Only) $3.25.

27196 (BNL-50360) BROOKHAVEN HIGHLIGHTS, JULY 1970-JUNE 1972. (Brookhaven National Lab., Upton, N. Y.). Jan 1973. Contract AT(30-1)-16. 82p. Dep. NTIS.

A broad general picture of improvements in research facilities and the principal research results for the biennium are highlighted. (CES)

27197 (BNWL-SA-2212) APPLICATION OF ACOUSTIC EMISSION TO IN-PROCESS WELD INSPECTION. Jolly, W. D. (Battelle Pacific Northwest Labs., Richland, Wash.). [nd]. Contract AT(45-1)-1830. 27p. (CONF-690311-2). Dep. NTIS $3.50.

From National spring conference of the american society for nondestructive testing; Los Angeles, California, USA (10 Mar 1969).

27198 (BNWL-SA-4175(Rev.)) PARTICLE RESUSPENSION FROM ASPHALT ROADS CAUSED BY CAR AND TRUCK TRAFFIC. Sehmel, G. A. (Battelle Pacific Northwest Labs., Richland, Wash.). May 1972. Contract AT(45-1)-1830. 37p. Dep. NTIS $4.00.

27199 (BNWL-SA-4302) INFLUENCE OF CLIMATOLOGICAL FLUCTUATIONS ON INSECT POPULATIONS IN SOUTH-CENTRAL WASHINGTON. I. The Darkling Beetle Philolithus Densicollis (Horn) (Coleoptera: Tenebrionidae). Hinds, W. T.; Rickard, W. H. (Battelle Pacific Northwest Labs., Richland, Wash.). Apr. 1972. 29p. (CONF-720676-1). Dep. NTIS $3.50.

27200 (BNWL-SA-4580) VEGETATIONAL STUDIES ON THE ALE RESERVE, 1972. Pickard, W. H.; Gilbert, R. O.; Cline, J. F. (Battelle Pacific Northwest Labs., Richland, Wash.). 1972. Contract AT(45-1)-1830. 49p. Dep. NTIS.

27201 (CEA-CONF-2136) TOXICITY OF LEAD. Lafuma, J. (Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Centre d'Etudes Nucleaires). [nd]. 8p. (In French). (CONF-720467-2). Dep. NTIS (U. S. Sales Only).

From Conference on the metabolism of lead in the human body; Luxembourg (25 Apr 1972).

27202 (CEA-CONF-2146) AUTOMATIC CALIBRATION SYSTEM FOR THE WAYS OF MEASUREMENT CONNECTED WITH A COMPUTER. Le Bot, B.; Neuville, J. C. (Commissariat a l'Energie Atomique, Paris (France)). 1972. 23p. (In French). (CONF-721139-3). Dep. NTIS (U. S. Sales Only).

From Conference on environmental science and technology; Versailles, France (22 Nov 1972).

27203 (CEA-CONF-2147) SEMI-AUTOMATIC ADOPTION OF THE MODES OF VIBRATION OF A STRUCTURE BY A NUMERICAL METHOD. Bouquin, J. M.; Moreau, J. L. (Commissariat a l'Energie Atomique (France). Centre d'Etudes Scientifiques et Techniques d'Aquitaine). 1972. 10p. (In French). (CONF-721139-2). Dep. NTIS (U. S. Sales Only).

From Conference on environmental science and technology; Versailles, France (22 Nov 1972).

27204 (CEA-CONF-2149) AUTOMATIC EQUIPMENT FOR REDUCTION OF THE AMOUNT OF HARMONIC DISTORTION OF VIBRATION EQUIPMENT IN THE SINUSOIDAL MODE. Andre, P.; Stadnikoff, W. (Commissariat a l'Energie Atomique, Paris (France)). 1972. 17p. (In French). (CONF-721139-1). Dep. NTIS (U. S. Sales Only).

From Conference on environmental science and technology; Versailles, France (22 Nov 1972).

27205 (CEA-CONF-2159) EFFECTS OF SPHERICAL ABERRATION AND DEFOCUSING ON IMAGES OF PERIODIC OBJECTS. Guigay, J. P. (Commissariat a l'Energie Atomique, Grenoble (France). Centre d'Etudes Nucleaires). 1971. 2p. (In French). (CONF-720913-2). Dep. NTIS (U. S. Sales Only).

From 5th European Congress on Electron Microscopy; Manchester, United Kingdom of Great Britain and Northern Ireland (UK) (5 Sep 1972).

27206 (CONF-720222-(Vol. 1)) PROCEEDINGS OF THE SYMPOSIUM ON ELECTRONICS, HYDERABAD; FEBRUARY 7-9, 1972. Volume I. Electron Tube and Semiconductor Devices. (Department of Atomic Energy, Bombay (India). Committee on Electronics). 1972. 245p.

From Symposium on electronics; Hyderabad, India (7 Feb 1972).

27207 (CONF-720222-(Vol. 2)) PROCEEDINGS OF THE SYMPOSIUM ON ELECTRONICS (ELECTRON TUBE AND SEMICONDUCTOR DEVICES), HYDERABAD, FEBRUARY 7-9, 1972. Volume II. (Department of Atomic Energy, Bombay (India). Committee on Electronics). 1972. 335p.

From Symposium on electronics; Hyderabad, India (7 Feb 1972).

27208 (CONF-730116-1) DELANEY AMENDMENT CONCEPT IN RELATION TO ENVIRONMENTAL CARCINOGENESIS. Lijinsky, W. (Oak Ridge National Lab., Tenn.). 1972. 5p. Dep. NTIS.

From Working group on the scientific basis for the Delaney Amendment; New Yrok, New York, USA (15 Jan 1973).

27209 (CONF-730206-1) FINE STRUCTURE OF ACTIVE GENES IN PROKARYOTES AND EUKARYOTES. Hamkalo, B. A.; Miller, O. L. Jr. (Oak Ridge National Lab., Tenn.). [nd]. 21p. Dep. NTIS.

From International symposium on control of transcription; Calcutta, India (12 Feb 1973).

27210 (CONF-730313-1) MODELING IN THE EASTERN DECIDUOUS FOREST BIOME. O'Neill, R. V. (Oak Ridge National Lab., Tenn.). 1973. 38p. Dep. NTIS.

From Symposium on ecosystem modeling; Athens, Georgia, USA (1 Mar 1973).

27211 (CONF-730317-1) SENSITIVE FLUORESCENCE MONITORING OF AROMATIC ACIDS AFTER ANION EXCHANGE CHROMATOGRAPHY OF BODY FLUIDS. Katz, S.; Pitt, W. W. Jr.; Jones, G. Jr. (Oak Ridge National Lab., Tenn.). 1973. 16p. Dep. NTIS $3.00.

From fifth annual symposium on advanced concepts for the clinical laboratory; Oak Ridge, Tennessee, USA (15 Mar 1973).

27212 (CONF-730403-1) AFFINITY CHROMATOGRAPHY OF HUMAN SERUM USING ANTISERA AGAINST "ALL BUT ONE" HUMAN SERUM PROTEINS. Attrill, J. E.; Caton, J. E.; Holladay, D. W.; Anderson, N. G. (Oak Ridge National Lab., Tenn.). 1972. 5p. Dep. NTIS.

From 165th meeting of the American Chemical Society; Dallas, Texas, USA (8 Apr 1973).

27213 (CONF-730404-1) METALLOGRAPHIC EXAMINATIONS OF RETRIEVED INTRAMEDULLARY BONE PINS AND BONE SCREWS FROM THE HUMAN BODY. Gray, R. J. (Oak Ridge National Lab., Tenn.). 1972. 13p. Dep. NTIS.

From 5th annual biomaterials symposium; Clemson, South Carolina, USA (14 Apr 1973).

27214 (COO-1422-126) DETERMINATION OF VERTEBRAL BONE MINERAL MASS BY TRANSMISSION MEASUREMENTS. Judy, P. F.; Cameron, J. R.; Jones, K. M.; Ort, M. G. (Wisconsin Univ., Madison. Dept. of Radiology). [nd]. 11p. (CONF-720731-1). Dep. NTIS $3.00.

From 3rd international conference on medical physics, including medical engineering; Goteborg, Sweden (30 Jul 1972).

27215 (COO-1422-131) RELATIONSHIP BETWEEN BONE MINERAL CONTENTS OF THE RADIUS FEMORAL NECK, THORACIC VERTEBRAE AND OTHER SITES. Wilson, C. R.; Cameron, J. R. (Wisconsin Univ., Madison. Dept. of Radiology). 1971. 14p. (CONF-720731-2). Dep. NTIS $3.00.

From third international conference on medical physics, including medical engineering; Goteborg, Sweden (30 Jul 1972).

27216 (COO-1794-15) EFFECT OF THE INTERFACE ON THE MECHANICAL PROPERTIES OF COMPOSITE MATERIALS. Broutman, L. J.; Agarwal, B. D. (Illinois Inst. of Tech., Chicago). 1972. Contract AT(11-1)-1794. 32p. (CONF-720930-3). Dep. NTIS.

From sixth international congress on rheology; Lyon, France (4 Sep 1972).

27217 (CTC-58) EXAMINATION OF SEVERAL METHODS OF ESTIMATION FOR ABO BLOOD GROUPS. Handley, B. J.; Bowman, K. O. (Union Carbide Corp., Oak Ridge, Tenn. Computing Technology Center). 14 Mar 1973. Contract W-7405-eng-26. 145p. Dep. NTIS $5.45.
Thesis. Submitted by B. J. Handley to Univ. of Tennessee, Knoxville.

27218 (EDFB-IBP-72-13) USE OF STOMATAL RESISTANCE, PHOTOPIGMENTS, NITROGEN, WATER POTENTIAL, AND RADIATION TO ESTIMATE NET PHOTOSYNTHESIS IN LIRIODENDRON TULIPIFERA L. A Physiological Index. Richardson, C. J.; Dinger, B. E.; Harris, W. F. (Oak Ridge National Lab., Tenn.). Apr 1973. Contract W-7405-eng-26. 143p. Dep. NTIS $3.00.
Thesis. Submitted by C. J. Richardson to Univ. of Tennessee, Knoxville.

27219 (EDFB-IBP-73-4) APPLICATION OF THE GREEN AND COREY METHOD FOR COMPUTING HYDRAULIC CONDUCTIVITY IN HYDROLOGIC MODELING. Luxmoore, R. J. (Oak Ridge National Lab., Tenn.). Apr 1973. Contract W-7405-eng-26. 24p. Dep. NTIS $3.00.

27220 (FRNC-CONF-39) MEASUREMENTS OF THE THERMAL DIFFUSIVITIES AND SPECIFIC HEATS OF SODIUM, POTASSIUM, AND ONE OF THEIR ALLOYS. Amoros, D.; Thirriot, C. (Institut National Polytechnique, Toulouse (France)). 1972. 10p. (In French). (CONF-720648-2). Dep. NTIS (U. S. Sales Only).
From twelfth meeting on hydraulics; Paris, France (6 Jun 1972).

27221 (HEDL-SA-287) ULTRASONIC ISOMETRIC IMAGING. Becker, F. L.; Trantow, R. L. (Hanford Engineering Development Lab., Richland, Wash.). Sep 1971. Contract AT(45-1)-2170. 14p. (CONF-711072-1). Dep. NTIS.

27222 (INR-1366) ONE-DIMENSIONAL DISTRIBUTION DENSITY AND THE MOMENTS OF A PROCESS AT THE OUTPUT OF A DOUBLE INERTIAL CIRCUIT FOR A STATIONARY INPUT PROCESS WITH POISSON DISTRIBUTION. Gasiorowski, L. (Institute of Nuclear Research, Warsaw (Poland)). 1972. 95p. (In Polish). Dep. NTIS (U. S. Sales Only) $6.75.

27223 (IS-M-1) HIGH-TEMPERATURE HEAT CONTENTS OF THE EUROPIUM CHALCOGENIDES: EuO, EuS, EuSe, AND EuTe. McMasters, O. D.; Gschneidner, K. A. Jr.; Kaldis, E.; Sampietro, G. (Ames Lab., Iowa). [nd]. 6p. (CONF-730402-3). Dep. NTIS.
From tenth rare earth research conference; Carefree, Arizona, USA (30 Apr 1973).

27224 (ISS-72/4) PROGRAM FOR AUTOMATIC ANALYSIS OF BIOLOGICAL PARAMETERS. Pastena, L.; Verdecchia, A. (Istituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica). 21 Apr 1972. 35p. (In Italian). Dep. NTIS (U. S. Sales Only) $3.75.

27225 (IS-T-574) ELECTRICAL CONDUCTANCES OF SOME AQUEOUS RARE-EARTH ELECTROLYTE SOLUTIONS FROM FIVE HUNDREDTHS MOLAL TO SATURATION AT 25°C. Rard, J. A. (Ames Lab., Iowa). Feb 1973. Contract W-7405-eng-82. 199p. Dep. NTIS $12.00.
Thesis.

27226 (IS-T-577) KINETIC THEORY OF DENSE GASES. The Calculation of the Viscosity and Thermal Conductivity Virial Coefficients. Occelli, M. L. (Ames Lab., Iowa). Feb 1973. Contract W-7405-eng-82. 137p. Dep. NTIS $9.00.
Thesis.

27227 (ITF-72-125-P) HYDRODYNAMIC EQUATIONS AND GREEN FUNCTIONS. Krasnikov, V. A.; Dzheparov, F. S. (Akademiya Nauk Ukrainskoi SSR, Kiev. Institut Teoreticheskoi Fiziki). 1972. 37p. (In Russian). Dep. NTIS (U. S. Sales Only) $4.00.

27228 (JINR-P4-6899) ASYMPTOTICALLY ACCURATELY SOLUBLE FERROMAGNETIC MODEL. Brankov, I. G.; Shumovskii, A. S. (Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics). 1973. 20p. (In Russian). Dep. NTIS (U. S. Sales Only).

27229 (KFK-1688) CAMAC INPUT/OUTPUT MODULES FOR BINARY SIGNALS. Heep, W.; Hellmann, G.; Stiefel, W. (Kernforschungszentrom, Karlsruhe (West Germany). Labor fuer Elektronik und Messtechnik). Jan 1973. 20p. (In German). Dep. NTIS (U. S. Sales Only) $3.00.

27230 (KFKI-72-46) PROBLEM-ORIENTED LANGUAGE HIERARCHY AND THE ENGAGEMENT OF LOGIC. Andreka, H.; Gergely, T.; Nemeti, I. (Magyar Tudomanyos Akademia Kozponti Fizikai Kutato Intezete, Budapest). 1972. 126p. Dep. NTIS (U. S. Sales Only) $8.50.

27231 (LA-5198-MS) USE OF HYDRAZINE COMPOUNDS TO INCREASE THE SPEED AND CONTRAST OF INDUSTRIAL RADIOGRAPHIC FILM. Sandoval, E. M.; Kearns, J. P. (Los Alamos Scientific Lab., N. Mex.). Feb 1973. Contract W-7405-eng-36. 17p. Dep. NTIS $3.00.

27232 (LA-UR-73-72) REMOVAL OF PHOSPHATES FROM WASTEWATERS WITH ELECTROCHEMICALLY GENERATED GADOLINIUM IONS. Onstott, E. I. (Los Alamos Scientific Lab., N. Mex.). 1971. 10p. (CONF-730402-7). Dep. NTIS.
From 10th rare earth research conference; Carefree, Arizona, USA (30 Apr 1973).

27233 (LBL-1299) ELECTRONIC DENSITIES OF STATES OF SOLIDS FROM X-RAY PHOTOEMISSION SPECTROSCOPY. Pollak, R. A. (California Univ., Berkeley. Lawrence Berkeley Lab.). Dec 1972. Contract W-7405-eng-48. 237p. Dep. NTIS $14.00.
Thesis.

27234 (LBL-1518) MICROSPHERE TRACER STUDIES OF PERIPHERAL VASCULAR SHUNTS. Schmidt, C. T. (California Univ., Berkeley. Lawrence Berkeley Lab.). Nov. 1972. Contract W-7405-eng-48. 81p. Dep. NTIS.
Thesis.

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